

PB-214 417

REPORT ON THE QUALITY OF THE WATER OF
THE LITTLE MIAMI RIVER AND TRIBUTARIES,
OHIO

C. E. Runas, et al

Environmental Protection Agency
Washington, D. C.

January 1971

DISTRIBUTED BY:

NTIS

National Technical Information Service
U. S. DEPARTMENT OF COMMERCE
5285 Port Royal Road, Springfield Va. 22151

PB 214 417

**REPORT ON THE
QUALITY OF THE WATER
OF THE
LITTLE MIAMI RIVER AND TRIBUTARIES
OHIO**

**RADIOLOGICAL ACTIVITIES SECTION
DIVISION OF TECHNICAL SUPPORT
WATER QUALITY OFFICE
ENVIRONMENTAL PROTECTION AGENCY
CINCINNATI , OHIO**

JANUARY 1971

Reproduced by
**NATIONAL TECHNICAL
INFORMATION SERVICE**
U.S. Department of Commerce
Springfield VA 22151

R
11

Report on the
Quality of the Water
of the
LITTLE MIAMI RIVER AND TRIBUTARIES
OHIO

C. E. Runas - Sanitary Engineer
L. P. Parrish - Aquatic Biologist
L. A. Resi - Microbiologist

Radiological Activities Section
Division of Technical Support
Water Quality Office
Environmental Protection Agency

January 1971

TABLE OF CONTENTS

	<u>Page No.</u>
<u>SUMMARY AND CONCLUSIONS</u>	1
<u>INTRODUCTION</u>	6
<u>AREA</u>	8
<u>WATER USES</u>	11
WATER QUALITY STANDARDS	12
<u>RESULTS OF STUDY</u>	14
BACTERIAL DATA	14
CHEMICAL DATA	19
<u>Dissolved Oxygen (DO) and Biochemical Oxygen</u> <u>Demand (BOD)</u>	19
<u>Nutrients</u>	21
<u>Dissolved Solids, Chlorides, and Sulfates</u>	25
<u>Turbidity and Color</u>	26
<u>pH</u>	27
<u>Arsenic and Cyanide</u>	27
<u>Fluoride</u>	28
<u>Cadmium, Chromium, Lead</u>	28
<u>Iron, Manganese, Zinc, Oil, Phenol</u>	29

TABLE OF CONTENTS

(continued)

	<u>Page No.</u>
BIOLOGY	30
<u>Little Miami River</u>	32
<u>Caesars Creek</u>	37
<u>Todd Fork</u>	38
<u>East Fork</u>	39

FIGURES

<u>Number</u>		<u>Follows Page No.</u>
1	GENERAL LOCATION MAP	6
2	COLIFORM BACTERIA	17
3	DISSOLVED OXYGEN	20
4	BIOCHEMICAL OXYGEN DEMAND	20
5	NITROGEN (NH ₃ - N)	24
6	NITROGEN (NO ₃ - N)	24
7	TOTAL AND SOLUBLE PHOSPHORUS	24
8	NUMBER OF KINDS OF BOTTOM ORGANISMS - Little Miami River	32
9	NUMBER OF BOTTOM ORGANISMS PER SQUARE FOOT - Little Miami River	32
10	NUMBER OF ORGANISMS PER SQUARE FOOT - Todd Fork and Caesars Creek	38
11	NUMBER OF KINDS OF BOTTOM ORGANISMS - Todd Fork and Caesars Creek	38
12	NUMBER OF KINDS OF BOTTOM ORGANISMS - East Fork - Little Miami River	40
13	NUMBER OF BOTTOM ORGANISMS PER SQUARE FOOT - East Fork - Little Miami River	40

TABLES

<u>Number</u>		<u>Page No.</u>
1	TOTAL AND FECAL COLIFORM DETERMINATIONS - Little Miami River Study	16 & 17
2	DO AND BOD RELATIONSHIPS - Little Miami River Study	22 & 23

APPENDIXES

A DETAIL MAP - Little Miami River and Tributaries

TABLES

1-A	- Reference Point Locations	44
2-A	- Benthic Organisms, Stations 1 - 17 .	45
3-A	- Benthic Organisms, Stations 18 - 36	48
4-A through		
46-A	- Summary of Chemical and Physical Data	51
E	WATER QUALITY STANDARDS - State of Ohio	94

SUMMARY AND CONCLUSIONS

The Little Miami River Basin is an area possessing the natural beauty of sharply contrasting topography of deep narrow gorges with rushing waters and broad flat bottom lands with quiet pools. The area, in addition to its scenic and picturesque beauty, is rich in sites of historical significance. These qualities give this area an unusual advantage for the expansion of its desirable recreational potential. Proposed multipurpose reservoir sites on Caesars Creek and in the East Fork are now being studied by the Corps of Engineers. These factors, as well as others, have prompted proposals to classify the Little Miami River, or selected reaches, as a "Wild River" or a "Scenic Recreation River."

The bacterial density of most of the 14 sampling stations investigated on the main stem of the Little Miami River violated the water quality standards established by the State of Ohio. Only one sample station (RM-88.5) had a mean coliform density of 1,000/100 ml or less as required for contact recreation and two other sampling stations (RM-95.6 and RM-51.3) had mean coliform values that conformed to the 5,000/100 ml standard for a public water supply. All but one of the

sampling stations on the main stem had fecal coliform counts in excess of the 200/100 ml limit for primary contact recreation recommended by the National Technical Advisory Committee on Water Quality Criteria. Pollution sensitive and tolerant organisms were present in the benthic population throughout the entire reach of the main stem, with snails and sludgeworms predominant in some reaches.

The bacterial water quality of the major tributaries to the Little Miami River was superior to that of the main stem. Caesars Creek, with the exception of the station at RM-18.3, met the total and fecal coliform standards for both contact recreation and water supply uses. Todd Fork met the water quality standards for both uses with the exception of its Lytle Creek tributary. Both Caesars Creek and Todd Fork supported a clean water benthic community. Out of a total of nine sampling points on the East Fork of the Little Miami River which is the largest and longest tributary, seven stations met the standard for public water supply and three of these seven met the standard for contact recreation. Greatest bacterial densities occurred near the mouth of the East Fork where pollution tolerant snails, clams and sludgeworms were predominant in the bottom animal population.

The average dissolved oxygen (D.O.) in the Little Miami River during the study period, equaled or was greater than the standards established by the State of Ohio for Aquatic Life Class A. The average D. O. remained consistently above 5.0 mg/l at all stations on both the main stem and tributaries. The D. O. exceeded the minimum allowable for Class A use at all but two stations where the minimum equaled 3.0 mg/l.

Although there were significant organic waste loads in some reaches of the Little Miami River, these wastes did not exert sufficient oxygen demand that the oxygen resources of the river were destroyed.

Total phosphorus concentrations in the Little Miami River were, in general, excessive with the National Technical Advisory Committee's recommended maximum of 0.1 mg/l for flowing streams being exceeded at all main stem locations. Algal streamers up to two feet in length were observed in some riffle areas. On the East Fork and Caesars Creek the total phosphorus concentrations approached the suggested upper limit of 0.1 mg/l for flowing streams. Abundant growths of periphyton covered the bottom of the stream in some areas of the East Fork. Since the proposed reservoirs on the East Fork and Caesars Creek would impound these waters, there exists the potential of an algal nuisance problem.

Total dissolved solids concentrations in the Little Miami River and tributaries were just below the limit of 500 mg/l average (750 mg/l maximum) established by the State of Ohio for waters used as a public water supply. The highest average concentration was 492 mg/l. The maximum concentration was 534 mg/l.

Concentrations of chlorides and sulfates at all stations were within the National Technical Advisory Committee's recommended limit of 250 mg/l. The highest chloride concentration at any station was 38 mg/l and the highest sulfate concentration was 68 mg/l.

Average turbidity at all stations in the Little Miami River and tributaries was below the 50 unit NTAC's recommended limit for warm water streams. The highest average observed at any station was 26 units. The highest single value of 52 units occurred at River Mile 3.4.

The highest average color in the Little Miami River and tributaries was 24 units. Thirty-five units was the highest value obtained.

The pH values in the Little Miami River and tributaries ranged from 5.3 to 8.8, within the range of 5.0 to 9.0 established by the State of Ohio. Any pH value within the range of 6.5 to 8.5 is considered desirable for aquatic life. This range was exceeded at only three stations: Mile 1.0 on Stonelick Creek, Miles 70.9 and 74.1 on the East Fork, with values of 8.6, 8.8, and 8.7, respectively.

During the study, alkalinity in the Little Miami River and tributaries remained below the National Technical Advisory Committee's recommended limit of 500 mg/l for public water supplies at all stations. The minimum hardness concentration was 160 mg/l and the average at all stations exceeded 200 mg/l during the study period. A maximum value of 348 mg/l was observed.

Concentrations of arsenic and cyanide did not exceed the limits of 0.05 mg/l and 0.025 mg/l, respectively, that were established by the State for the Little Miami River. Concentrations of arsenic ranged from less than 0.01 mg/l to 0.03 mg/l and concentrations of cyanide were less than 0.01 mg/l at all stations.

Fluoride concentrations remained below the level of 1.0 mg/l set by the State for waters used as a public water supply. Values ranged between 0.2 mg/l and 0.8 mg/l.

At all stations in the Little Miami River and its tributaries the concentrations of cadmium were less than the 0.01 mg/l limit. Concentrations of total chromium were less than 0.02 mg/l, which is less than the allowable limit of 0.05 mg/l for hexavalent chromium alone.

Copper and zinc concentrations were less than the National Technical Advisory Committee's recommended limits of 1.0 mg/l and 5 mg/l, respectively, for public water supplies at all stations. Iron concentrations exceeded the 0.3 mg/l NATC's recommended limit for waters used as a public water supply at all main stem and tributary stations, with the exception of the reach in the East Fork between Batavia and Williamsburg (RM-11.8-32.7). Manganese, oil and phenol concentrations exceeded the NATC's recommended limits for water supplies at all stations. Oily substances can be deleterious to fish by removing a source of fish food through a coating of algae and other plankton, and by coating the gills, interfering with respiration. Oil and phenolic substances may also be ingested by fish, tainting their flesh.

INTRODUCTION

This report on the quality of the water of the Little Miami River Basin is based on information obtained during the April 29 - July 12, 1968, field investigation conducted by personnel of the National Field Investigations Center, Federal Water Pollution Control Administration.

The study was initiated as a result of a request by the Ohio Basin Regional Director for assistance to provide background information on water quality in the Little Miami River Basin.

River discharge data were provided by the Lower Ohio Basin Office, Ohio Basin Region. Stream discharges were estimated, based on drainage areas from unpublished data from U. S. Geological Survey stream-gaging stations, and on drainage areas as established from "Drainage Areas of Ohio Streams," Ohio Department of Natural Resources, 1967.

The description of river water quality, as related to existing water quality standards, is based on the results of a two-phase field investigation. The first phase involved a biological and limited scope

FIGURE 1
GENERAL LOCATION
LITTLE MIAMI RIVER STUDY
OHIO



chemical study of the tributaries to the Little Miami River during the months of April and May 1968 (Figure 1). Air and water temperature, pH, and dissolved oxygen were determined in the field. Samples were collected and returned to the laboratory for analyses of nutrients (nitrogen and phosphorus), coliform bacteria, and biological examinations. Benthic organisms were collected with a Petersen dredge or Surber sampler. Dredged material was screened with a U. S. Standard No. 30 mesh sieve. Organisms and other material collected by the sieve or in the Surber, or square foot sampler, also were preserved for later examination. Qualitative benthic samples were obtained by searching all aquatic habitats in the area of each sample station.

The second phase of the field work, during June and July 1968, was an intensive two-week sampling program on the main stem of the Little Miami River and those tributaries that required additional study as indicated by the results from Phase I. Each station was sampled once daily during this period. The program involved daytime sampling during the first week and nighttime sampling during the second week to determine any diurnal differences.

AREA

The Little Miami River originates in Clark County, southeast of Springfield, Ohio, and flows in a general southwesterly direction for about 106 river miles through Greene, Warren, Clermont, and Hamilton Counties to the eastern suburbs of the Cincinnati of Cincinnati, where it discharges to the Ohio River. The total 1,755 square mile drainage area of the Little Miami River Basin includes all or part of 12 counties in southwestern Ohio. The area lies principally in the Green, Warren, Clinton, and Clermont Counties.

The main tributaries to the Little Miami River are: Caesars Creek, Todd Fork, and East Fork. Sections of these tributaries flow through Clinton, Highland, Brown, and Clermont Counties.

The topography is level to gently rolling in the upper and central sections, and rolling and hilly in the lower section. The entire area is underlain by consolidated rocks of sedimentary origin, including shale, limestone, and dolomite. Glaciation has affected the watershed, filling major drainageways with outwash materials of primarily coarse sand and gravel. Most of the upland areas are covered with till composed of clay, sand, and boulders.

Sustained flows occur in the upper reaches of the main stem supplied from storage in the permeable glacial outwash deposits. The tributary streams have less sustained flow due to impermeable clays and other compacted glacial till deposits. There are no natural lakes in the area. The largest bodies of water are impoundments constructed by the State of Ohio: Stonelick Lake, near Edenton in Clermont County, and Cowan Lake, near Wilmington in Clinton County. Proposed multipurpose reservoir sites on Caesars Creek, near Harveysburg, and on the East Fork, near Batavia, are being studied by the Corps of Engineers.

In 1960 the basin population was 475,570 persons, with the principal population centers located at Kettering, Xenia, Wilmington, and Norwood. Other population centers include South Lebanon, Loveland, and Milford on the main stem, and Williamsburg and Batavia on the East Fork. By 1975 the population of the area is expected to grow to 875,000 persons and to 1,750,000 persons by the year 2000. This growth is expected to take place primarily in Greene, Clermont, and Hamilton Counties.

Major industrial activities in the basin include food processing and furniture and machinery manufacturing at Xenia, machine tool and casting production at Wilmington, and heating equipment and structural steel fabrication at Lebanon. Cattle, hog, and poultry raising, dairy farming, and corn and wheat growing are the principal agricultural activities in the basin.

The area, in addition to its natural beauty of sharply contrasting topography of deep narrow gorges with rushing waters and broad flat

bottom lands with quiet pools, is rich in sites of historical significance. These factors, as well as others, have prompted proposals to classify the Little Miami River, or selected reaches, as a "Wild River" and/or a "Scenic Recreation River."

WATER USES

Municipal water supplies, serving about 125,000 persons, draw approximately 12.5 mgd of water from the Little Miami River Basin. Ground water provides approximately 85 percent of the water supply for 28 existing central water systems. Surface water supply sources presently in use are: the East Fork Little Miami River, Stonelick Creek, Todd Fork, and Cowan Creek. The largest system using surface water as a supply serves 10,000 persons with 0.9 mgd at Wilmington, Ohio.

Industrial water supplies use nearly 4.5 mgd of water from wells. In the Little Miami Basin over 120 water-using manufacturing plants employ nearly 21,000 persons. Major water users are the manufacturers of transportation equipment, food and kindred products, and chemicals. The major portion of the water is used as process water.

The total municipal and industrial water demand is expected to triple by the year 2020, but no major demand on the surface water of the basin for public water supply is expected.

Fishing and boating are the major recreational uses of the Little Miami River. It is estimated that \$15,000,000 is spent annually by the

136,000 fishermen residing in the basin. Fishing, in general, is good throughout the main stem and larger tributaries. Pleasure boating in the Little Miami River is increasing in popularity. The reach from Clifton to Cincinnati, a distance of about 95 river miles, is an excellent canoeing stream with a few sections offering the challenge of white water canoeing. Cowan Lake is known as a site for sailboating. To provide for the increasing demands for boating in this area, additional launching facilities are planned for the Little Miami River and Cowan Lake. Swimming is a recognized use in a few locations in the basin, particularly at Stonelick Lake. Additional water-oriented recreation areas will be provided by the proposed reservoirs on the East Fork and Caesars Creek.

The Little Miami River receives silt and wastes from agricultural runoff, treated and untreated sewage, and industrial wastes. The growth and development of the area will cause greater pollutional problems and at the same time increase public demand for aesthetic enjoyment and recreation.

WATER QUALITY STANDARDS

Water Quality Standards have been established by the State of Ohio for the Little Miami River Basin. Provisions regarding water quality as adopted by the State of Ohio appear in Appendix C.

The water quality in the Little Miami River Basin as it relates to these standards is discussed in this report. Where State standards have

not been established, reference is made to recommendations of the
National Technical Advisory Committee on Water Quality Criteria.

RESULTS OF STUDY

The results of all bacteriological, biological, chemical, and physical determinations are tabulated in summary form in Appendix A.

BACTERIAL DATA

Though some members of the coliform group are widely distributed in nature, coliform bacteria are always present in excretions from the intestinal tract of humans and other warm-blooded animals. Therefore, the absence of coliform bacteria is evidence of a bacteriologically safe water. The presence of fecal coliform bacteria in the water environment is proof of fecal contamination and an indication of hazardous pollution.

Thirty-five sample stations were established in the Little Miami River Basin: nine on the East Fork; five on Todd Fork; three on Caesars Creek; single stations on four other tributaries in the upper reaches of the river; and 14 stations on the main stem.

Bacterial water quality standards established by the State of Ohio for the Little Miami River Basin are summarized below.

For waters used for a public supply, total coliform densities are not to exceed a monthly average (either MPN or MF count) of 5,000/100 ml nor exceed 20,000/100 ml in more than five percent of the samples.

For waters used for recreational purposes, including water-contact activities such as swimming and water skiing, total coliform densities are not to exceed a monthly average (either MPN or MF count) of 1,000/100 ml nor exceed 2,400/100 ml at any time.

Although the State of Ohio does not include fecal coliform in the bacterial water quality standards, the National Technical Advisory Committee on Water Quality Criteria recommends that the fecal coliform content of primary contact recreation waters shall not exceed a mean of 200 MPN/100 ml nor shall more than ten percent of the total samples during any 40-day period exceed 400 MPN/100 ml.

Detailed tabulation of coliform data by the membrane filter method is posted in Table 1 and density trends are illustrated on Figure 2.

The 30-mile upstream reach of the Little Miami River, upstream from Xenia, flows gently through the rolling plains, farmland area of southwestern Ohio. There are no known sewage discharges into these clear and attractive waters, and the source of the relatively low total coliform densities observed at the two sampling stations within this reach (1,200/100 ml and 470/100 ml) was probably runoff from farmlands. This reach contained the only sampling point within the entire main stem where

TABLE 1

LITTLE MIAMI RIVER STUDY

Total and Fecal Coliform Determinations
By Membrane Filter Method

<u>River Mile</u>	<u>Sta. No.</u>	<u>Total Coli/100 ml</u>			<u>Fecal Coli/100 ml</u>		
		<u>Max.</u>	<u>Min.</u>	<u>Mean</u>	<u>Max.</u>	<u>Min.</u>	<u>Mean</u>
<u>Little Miami Main Stem</u>							
95.6	35	5,200	500	1,200	800	70	260
88.5	33	900	320	470	340	64	120
<u>Massie Creek, Shawnee Creek</u>							
75.8	32	170,000	1,900	12,000	40,000	350	1,800
<u>Glady Run, Beaver Creek</u>							
63.4	29	17,000	7,700	11,000	3,900	1,200	2,100
51.3	28	14,000	100	1,500	13,000	50	510
<u>Caesars Creek Enters</u>							
45.7	24	28,000	13,000	19,000	3,000	1,100	1,700
<u>Todd Fork Enters</u>							
35.8	18	66,000	2,500	12,000	23,000	310	1,600
33.1	17	58,000	1,200	11,000	22,000	590	2,200
<u>O'Bannon Creek Enters</u>							
21.1	15	79,000	25,000	44,000	23,000	1,300	6,200
17.6	14	490,000	23,000	83,000	140,000	4,500	16,000
12.7	13	62,000	6,700	19,000	8,900	840	3,900
<u>East Fork Little Miami Enters</u>							
10.4	3	39,000	4,000	14,000	8,500	990	2,800
7.8	2	44,000	1,000	4,700	7,600	350	1,300
3.4	1	233,000	1,000	18,000	33,000	150	2,800

TABLE 1 (contd)

LITTLE MIAMI RIVER STUDY

Total and Fecal Coliform Determinations
By Membrane Filter Method

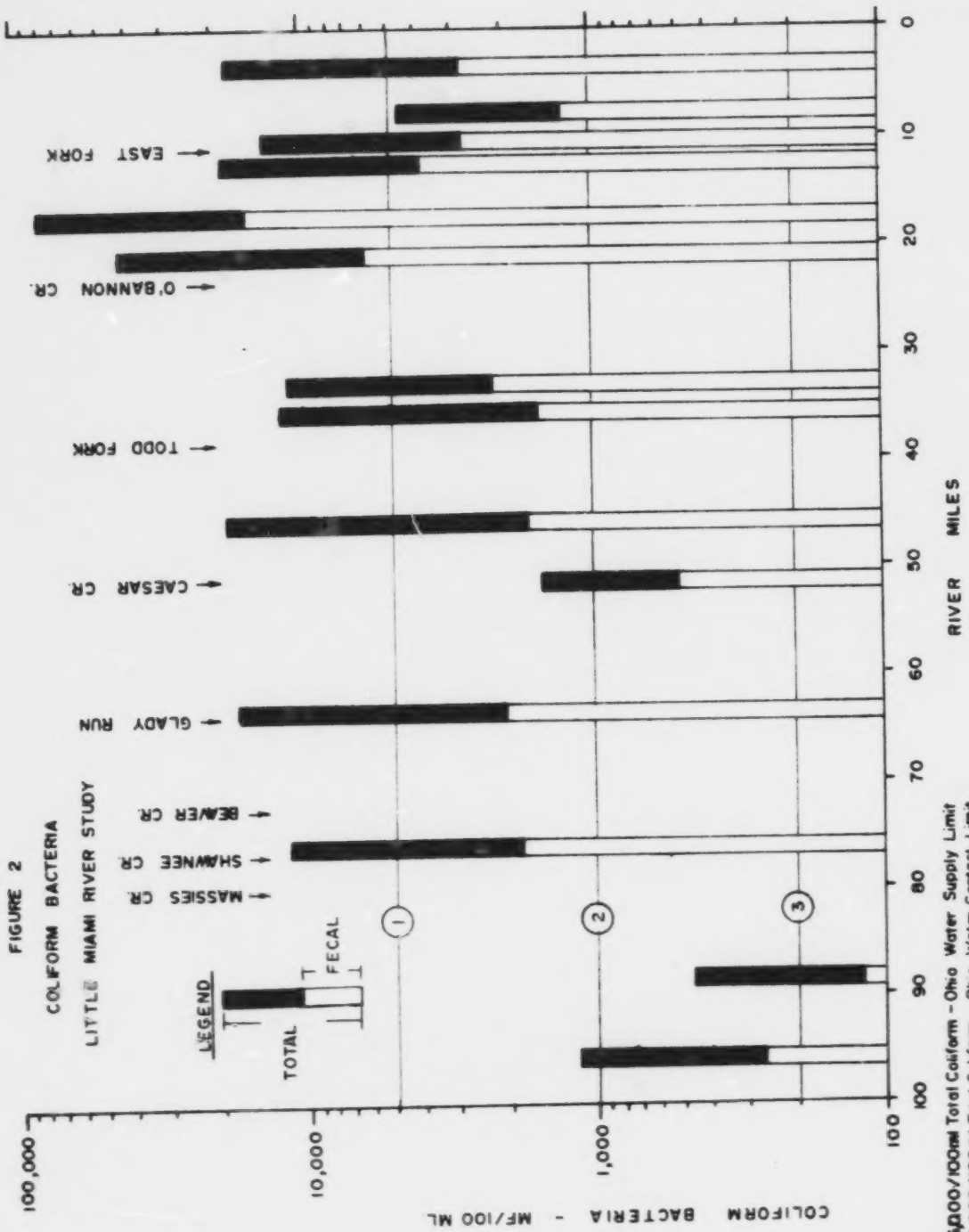
River Mile	Sta. No.	Total Coli/100 ml			Fecal Coli/100 ml			
		Max.	Min.	Mean	Max.	Min.	Mean	
<u>Tributaries</u>								
79.9-0.2	34	20,000	1,600	7,000	3,100	150	1,100	Massie Creek
72.6-1.8	31	3,100	160	470	1,900	40	265	Beaver Creek
63.7-1.1	30	100,000	25,000	46,000	48,000	3,000	9,000	Gladys Run
51.0-18.3	27	2,300	230	840	1,400	130	550	Caesars Creek
51.0-6.2	25	920	150	350	250	85	120	Caesars Creek
51.0-13.7-0.2	26	2,000	120	420	1,300	100	200	Anderson Fork
38.4-19.5	23	500	180	250	98	50	71	Todd Fork
38.4-14.4	20	350	230	290	68	50	58	Todd Fork
38.4-1.8	19	260	160	200	48	18	27	Todd Fork
38.4-18.5-0.6	22	3,000	200	1,200	280	90	130	Lytle Creek
38.4-17.0-0.5	21	1,000	230	530	460	30	97	Cowan Creek
23.6-2.0	16	420	180	280	80	56	64	O'Bannon Creek
<u>East Fork Little Miami</u>								
11.1-74.1	12	3,200	900	1,600	770	470	600	
11.1-70.9	11	8,200	3,900	6,100	1,500	560	1,100	
11.1-54.7	10	700	560	600	330	320	330	
11.1-35.8	9	28,000	360	1,600	14,000	54	400	
11.1-32.7	8	4,100	560	1,000	420	120	160	
11.1-15.5	7	3,900	320	740	2,200	54	140	
11.1-11.8	6	5,100	300	760	1,200	100	260	
<u>Stonelick Creek Enters</u>								
11.1-0.7	4	70,000	9,500	35,000	19,000	1,300	7,000	(Increase not due to Stonelick Cr.)
11.1-8.6-1.0	5	480	420	460	142	34	67	Stonelick Creek

the total coliform density was less than the 1,000/100 ml total coliform and 200/100 ml fecal coliform limit for contact recreation.

Treated and untreated sewage from Xenia along the banks of Shawnee Creek and Glady Run, and the residual wastes that enter Beaver Creek from Kettering, enter the Little Miami River within the next 15-mile downstream reach. The effects of these bacterial loads were revealed in the next two downstream sampling stations by the sharp total coliform density increase to an average of 11,000/100 ml at River Mile 63.4 downstream from the entrance of Glady Run. Fecal coliform densities increased to an average of 2,100/100 ml at this Station.

There are no known additional sources of pollution within the next 12 miles of flowing stream and at River Mile 51.3, at Waynesville, the total and the fecal coliform densities were reduced to 1,500/100 ml and 510/100 ml, respectively.

The average total coliform densities exceeded the 5,000/100 ml limit for general recreation at all but one station sampled within the remaining 50-mile reach from Waynesville down to the mouth. Except for the station at Newtown, where the total coliform density averaged 4,700/100 ml, average total coliform densities ranged from 11,000/100 ml to 83,000/100 and average fecal coliforms ranged from 1,600/100 ml to 16,000/100 ml within this 50-mile reach. Significant discharges of raw and treated sewage within this problem area of excessive bacterial pollution originate mainly in Waynesville, Wilmington, Lebanon, Loveland, Milford, and Newtown.



As shown below, mean total coliform (T.C.) and fecal coliform (F.C.) densities exceeded the recommended limits for water supply and contact recreation near the mouths of three tributary streams: Massie Creek, Gladly Run, and East Fork Little Miami River.

Massie Creek (7,000/100 ml T.C. - 1,100/100 F.C.)

Sewage from Cedarville enters Massie Creek upstream from this sample station.

Gladly Run (46,000/100 ml T.C. - 9,000/100 ml F.C.)

Part of the treated and untreated wastes from Xenia enter Gladly Run.

East Fork Little Miami River (35,000/100 ml T.C. - 7,000/100 ml F.C.)

Treated and untreated wastes from the densely settled area in and near Milford enter the East Fork near the mouth.

Except for 1,200/100 ml in Lytle Creek, the mean total coliform densities were less than 1,000/100 ml in the other tributaries. With the exception of 550/100 ml at River Mile 18.3 in Caesars Creek and 265/100 ml at River Mile 1.8 in Beaver Creek, the mean fecal coliform densities were less than the 200/100 ml primary contact limit.

CHEMICAL DATA

Dissolved Oxygen (DO) and Biochemical Oxygen Demand (BOD)

Municipal and many industrial wastes contain organic matter that is biochemically degraded and exerts an oxygen demand on the receiving waters. In the process of biochemical degradation of organic matter the dissolved oxygen derived from the atmosphere and photosynthesis is

reduced. High concentrations of the oxygen-demanding matter can cause excessive dissolved oxygen depletion, and result in a reduction of desirable aquatic life, including fish. When wastes are strong enough for the creation of an anaerobic condition, offensive odors result.

Dissolved oxygen standards established by the State of Ohio for the Little Miami River include:

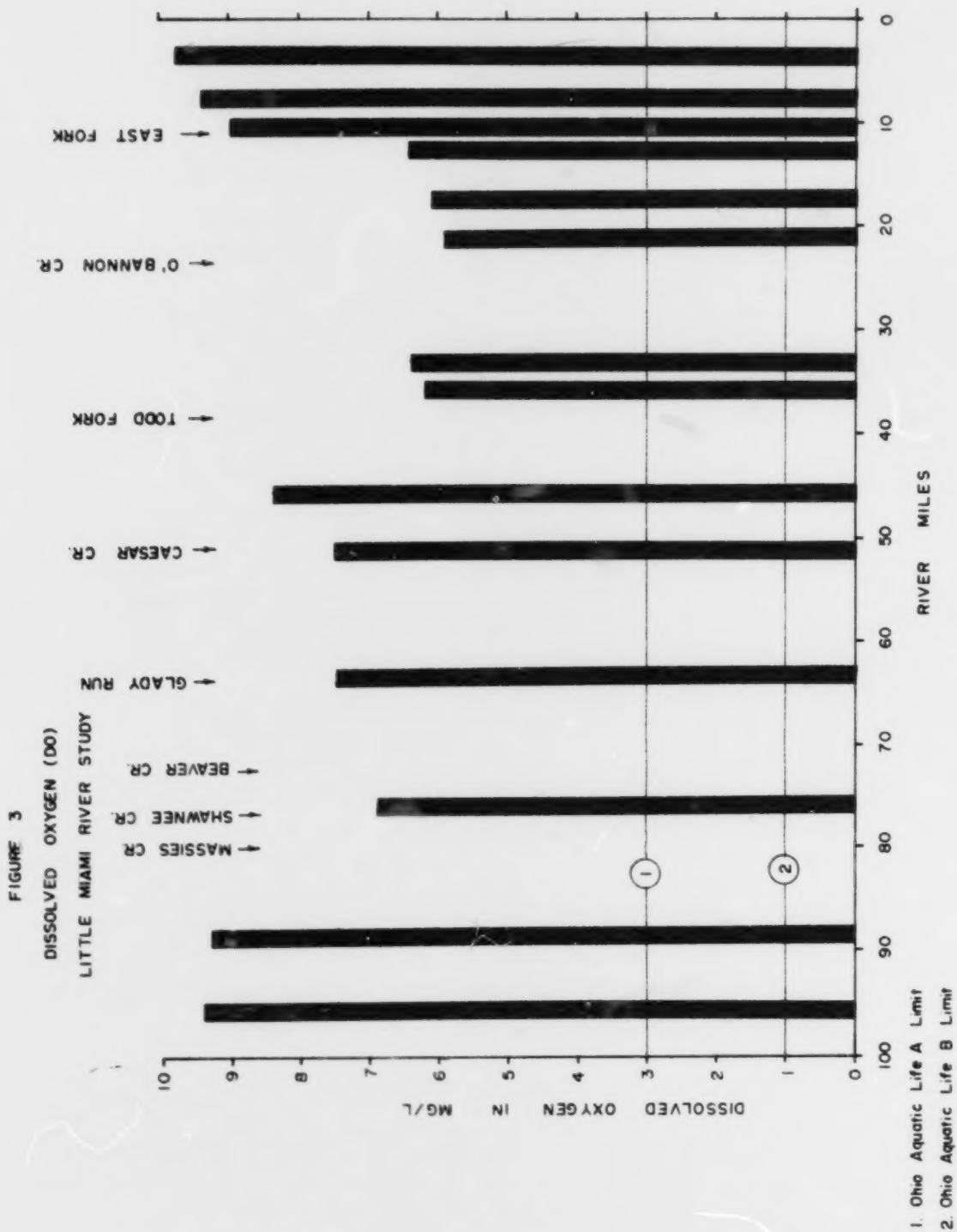
For Aquatic Life A

For the maintenance of a well-balanced warm-water fish population the dissolved oxygen concentrations in the stream are to be not less than 5.0 mg/l during at least 16 hours of any 24-hour period, nor less than 3.0 mg/l at any time.

For Aquatic Life B

For the maintenance of desirable biological growths and, in limited reaches of the stream, for permitting the passage of fish through the water, the dissolved oxygen concentrations are to be not less than 2.0 mg/l as a daily average, nor less than 1.0 mg/l at any time.

The average dissolved oxygen values in the Little Miami River equaled or exceeded the standards for DO for both Aquatic Life Classes A and B (Figure 3). The average DO remained consistently above 5.0 mg/l at all stations on both the main stem and the tributaries. The minimum DO equaled or exceeded the minimum allowable 3.0 mg/l for Class A use at all stations. Diurnal differences in dissolved oxygen concentrations were not significant.



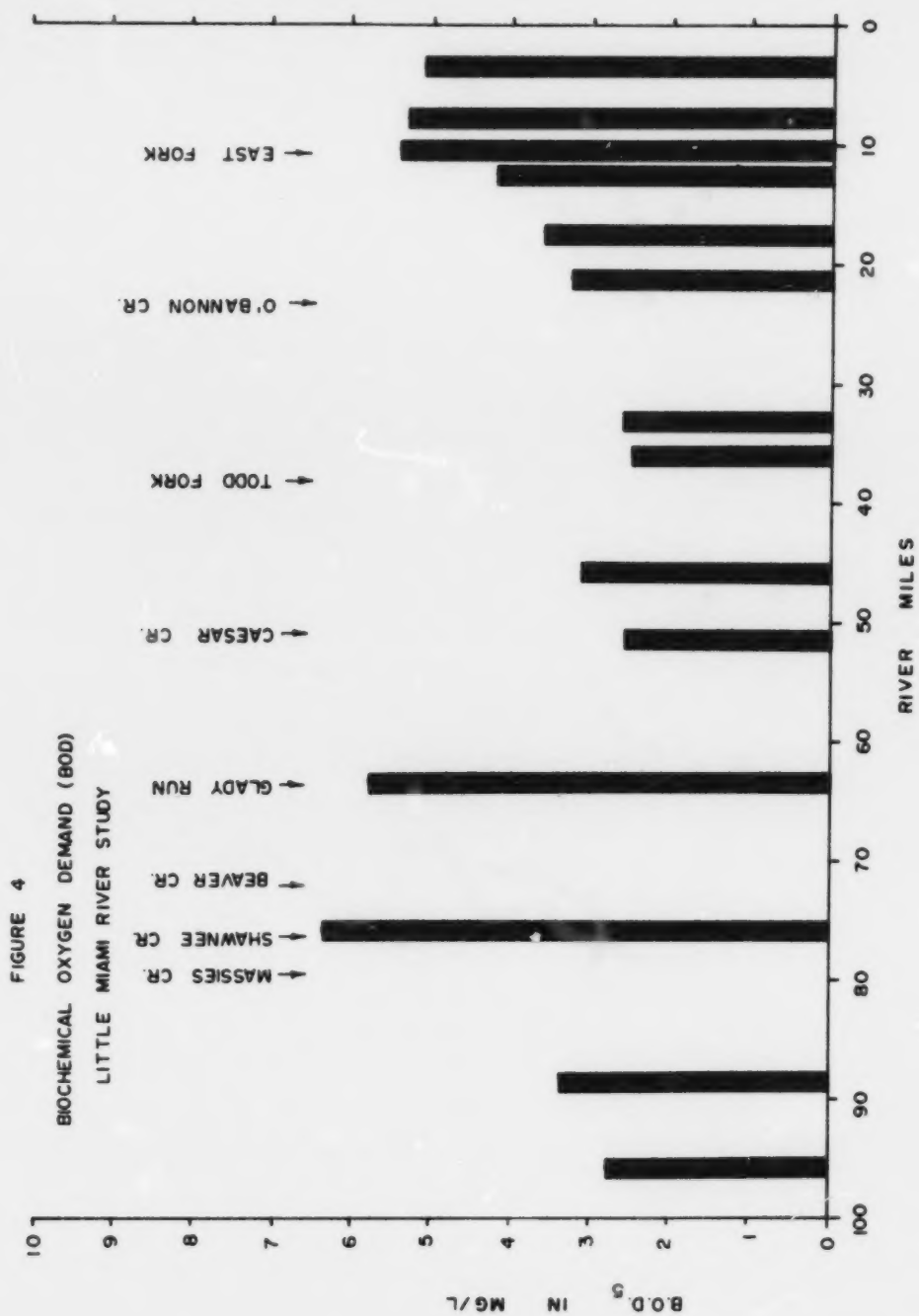


FIGURE 4
BIOCHEMICAL OXYGEN DEMAND (BOD)
LITTLE MIAMI RIVER STUDY

Though oxygen-demanding wastes did not lower the dissolved oxygen concentration below the levels set by State Standards, the observed 5-day biochemical oxygen demand of the river increased in some of the areas subjected to known waste loadings (Figure 4, Table 2).

River BOD's increased to an average of about 6 mg/l below Xenia (RM-63.7); but remained within a relatively narrow range of from 2.5 to 3.5 mg/l for 70 miles from the headwaters to Loveland. Along the final 30 miles to the mouth, where population densities increased, the BOD rose to the range of 3.2 to 5.5 mg/l.

Nutrients

The two most significant nutrients influencing biotic production and nuisance aquatic plant growths are nitrogen and phosphorus. As nutrient concentrations in streams increase, and if physical factors such as turbidity, velocity, etc. are not limiting, the numbers of algal cells increase, leading to such nuisance conditions as surface scums, odors, and water treatment problems. There are several important sources of nitrogen and phosphorus in the environment, including domestic sewage effluents, industrial effluents, agricultural runoff, animal and plant processing wastes, detergents, and the atmosphere. Nutrients can also be released to the stream from bottom sediments and from decomposing plant and animal matter.

Although the State of Ohio has not established limits for nutrients in the Little Miami River, a general guideline recommended by

TABLE 2
LITTLE MIAMI RIVER STUDY
DO & BOD Relationships

<u>River Mile</u>	<u>Flow cfs</u>	<u>mg/l</u>	<u>BOD lbs./day</u>	<u>lbs. increment</u>	<u>DO mg/l</u>
<u>LITTLE MIAMI RIVER MAIN STEM</u>					
95.6	17	2.8	260		9.4
				+ 380	
88.5	35	3.4	640		9.3
				+2,125	
75.8	80	6.4	2,765		6.9
				+1,620	
63.4	140	5.8	4,385		7.5
				-2,140	
51.3	160	2.6	2,245		7.5
				+1,775	
45.7	240	3.1	4,020		8.4
				+2,980	
35.8	475	2.5	7,000		6.2
				+ 370	
33.1	481	2.6	7,370		6.4
				+2,790	
21.1	579	3.3	10,160		5.9
				+1,900	
17.6	602	3.6	12,060		6.1
				+1,240	
12.7	609	4.2	13,300		6.4
				+6,335	
10.4	624	5.4	19,635		9.0
				- 985	
7.8	624	5.3	18,650		9.4
				- 50	
3.4	639	5.1	18,600		9.8

TABLE 2
(contd)
LITTLE MIAMI RIVER STUDY

DO & BOD Relationships

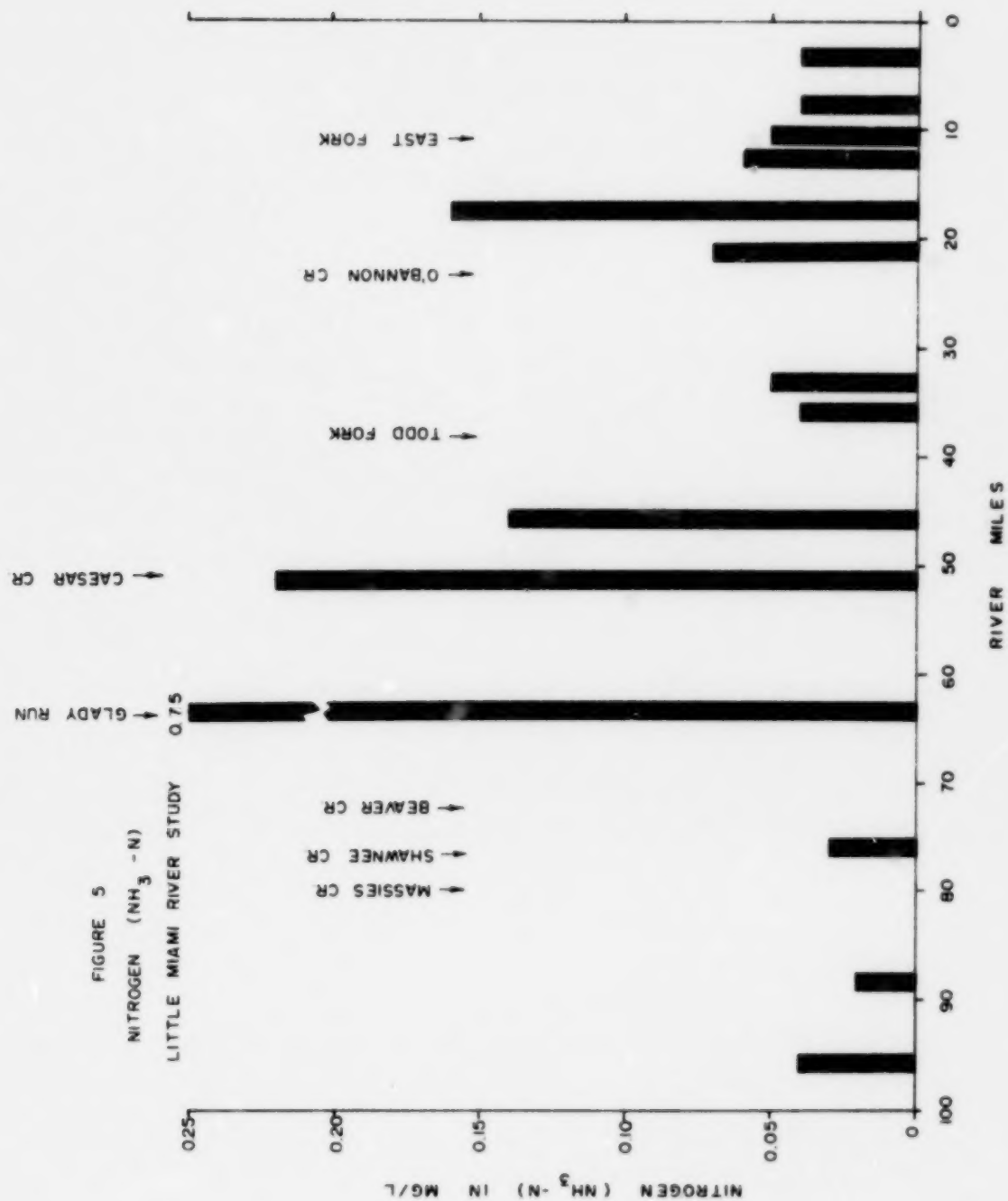
<u>River Mile</u>	<u>Flow cfs</u>	<u>mg/l</u>	<u>BOD lbs./day</u>	<u>lbs. increment</u>	<u>DO mg/l</u>
<u>EAST FK. LT. MIAMI RIVER</u>					
11.1-35.8	20	2.8	326		6.7
				- 83	
11.1-32.7	20	2.1	243		7.0
				+ 222	
11.1-15.5	23	3.2	465		7.3
				+ 130	
11.1-11.8	23	4.4	595		8.1
				+ 595	
11.1-0.7	32	6.6	1,190		10.2

the National Technical Advisory Committee on Water Quality Criteria, is that the concentration of total phosphorus should not exceed 0.1 mg/l in flowing streams or 0.05 mg/l in streams that enter lakes or reservoirs. Furthermore, the naturally occurring inorganic nitrogen to phosphorus ratio and the concentrations of each characteristic to clean water reaches of the stream should not be radically changed through the addition of foreign materials.

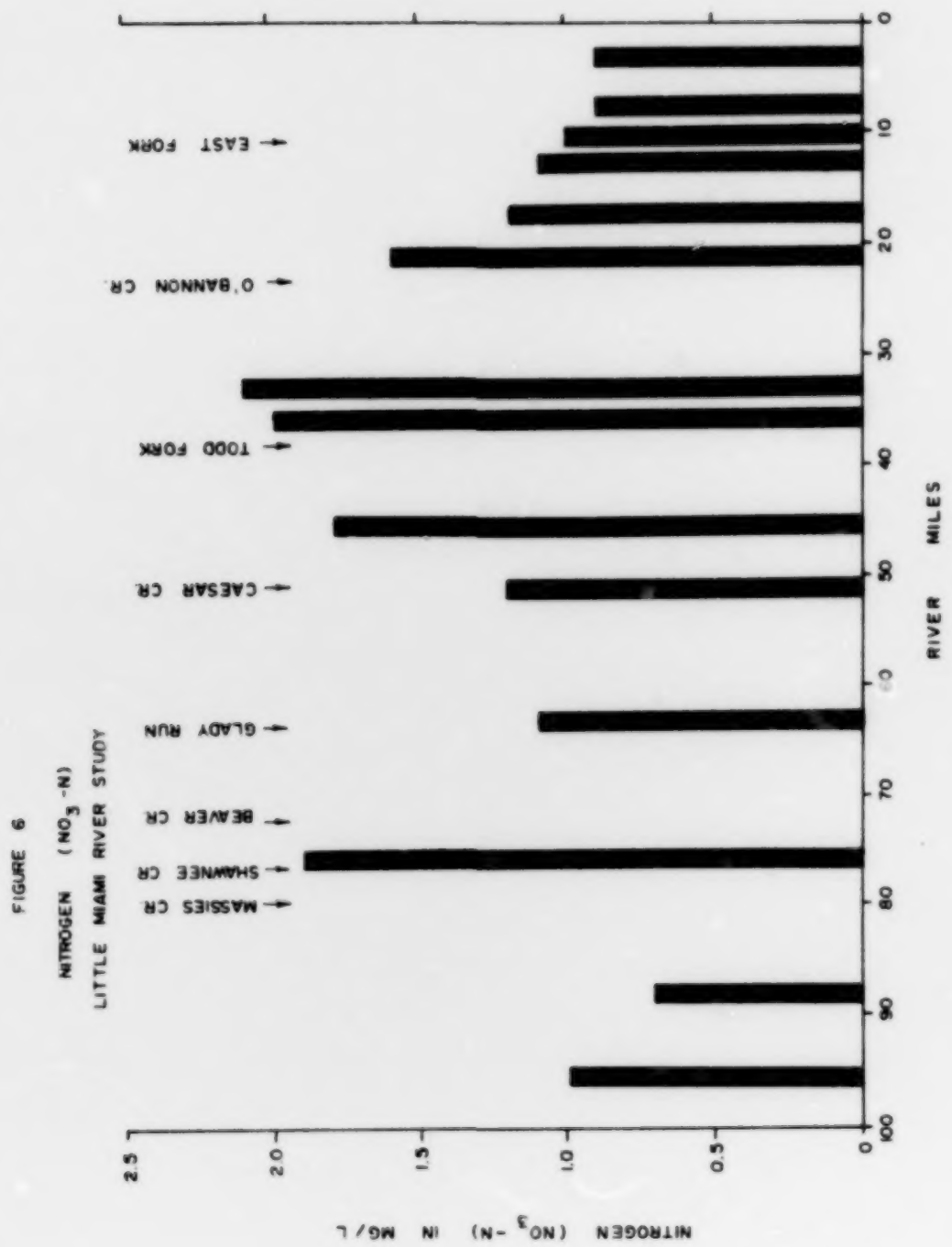
Concentrations of nitrogen (NH_3 -N and NO_3 -N) and total and soluble phosphorus in the Little Miami River during the study are shown in Figures 5, 6, and 7.

Except at River Mile 88.5, downstream from Clifton, phosphorus at all main stem stations on the Little Miami River exceeded the recommended maximum of 0.1 mg/l. On the East Fork, the total phosphorus concentrations ranged from a minimum of 0.03 mg/l at the headwaters to 0.35 mg/l near the confluence with the Little Miami River. In the Batavia area, the site of the multipurpose reservoir proposed for the East Fork, the total phosphorus concentrations ranged from 0.06 mg/l to 0.13 mg/l. On Caesars Creek, the site of the other proposed multipurpose reservoir, the total phosphorus concentrations ranged from 0.03 mg/l to 0.09 mg/l.

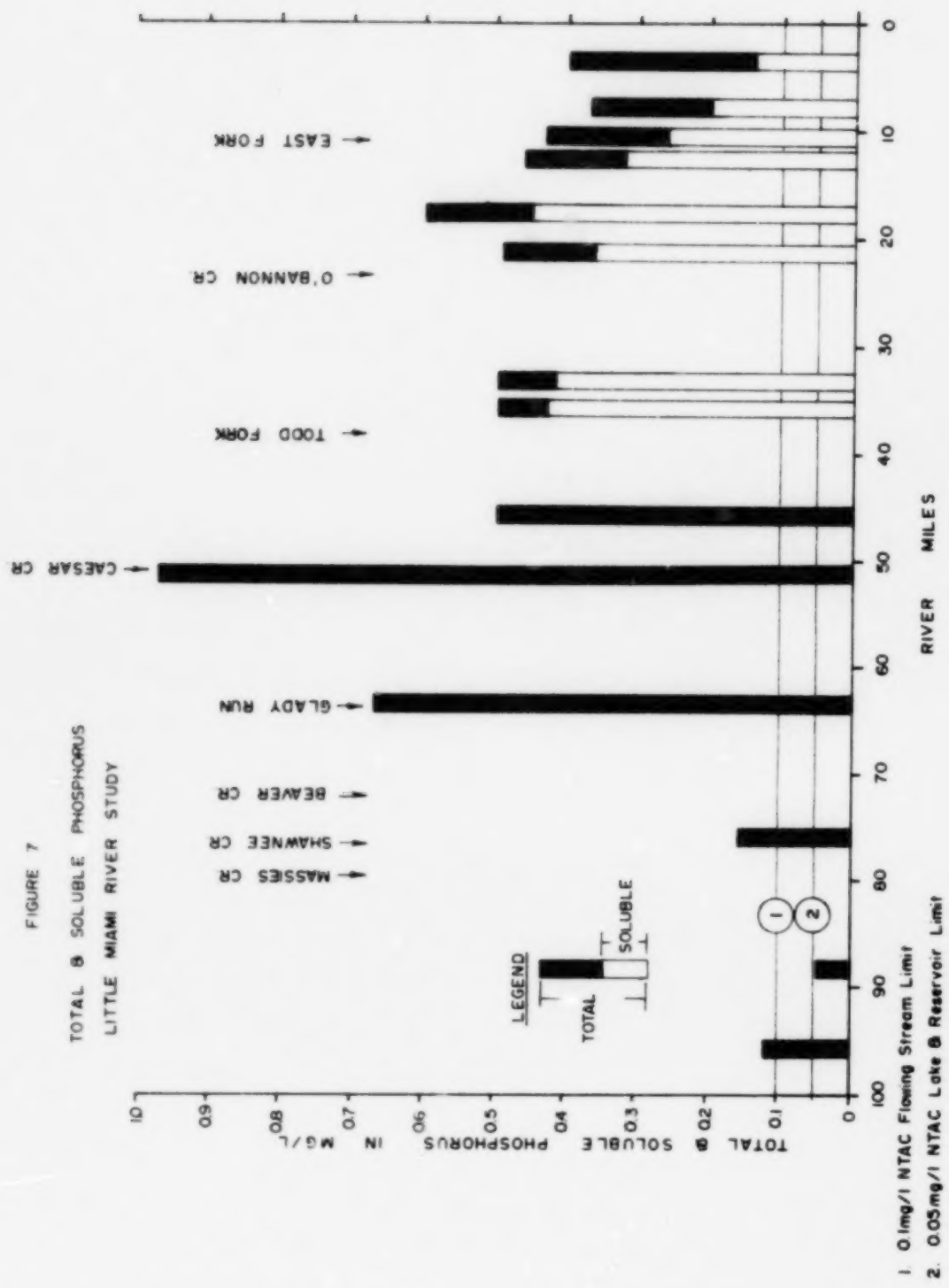
Because of the relatively high total phosphorus concentrations in the Little Miami River (near or greater than the suggested upper limit for flowing streams) and the fact that the proposed reservoirs will impound these waters, there exists the potential of an algal nuisance problem in the impoundments.



24B



240



Dissolved Solids, Chlorides and Sulfates

Dissolved solids, chlorides and sulfates are important in their effect on water quality since they can impart undesirable tastes and laxative properties to the water when present in excessive concentrations. The effect on aquatic life of substances added to natural waters is dependent on the substances already present making it difficult to impose a numerical limit. The National Technical Advisory Committee recommends that, to maintain local conditions, the total dissolved material in a stream should not be increased by more than one-third of what is characteristic of the natural conditions of such a stream nor exceed 50 milliosmoles (the equivalent of 1500 mg/l NaCl).

The State of Ohio has established a standard for total dissolved solids for water used as a public water supply. This standard states that the total dissolved solids concentration is not to exceed 500 mg/l as a monthly average, nor exceed 750 mg/l at any time. Numerical standards have not been established by the State of Ohio for chlorides and sulfates. However, the National Technical Advisory Committee on Water Quality Criteria has recommended that a limit of 250 mg/l for chlorides and sulfates not be exceeded.

Total dissolved solids concentrations in the Little Miami River and its tributaries met the water supply standards and were well below safe levels for aquatic life. Average concentrations ranged from 450 to 490 throughout the main stem of the Little Miami River. With the exception of the 505 mg/l concentration in Gladys Run, tributary streams contained approximately 100 mg/l less than the main stem (322 to 373).

Average sulfate and chloride concentrations were less than one-fourth of the 250 mg/l limit at all stations. The maximum observed sulfate and chloride concentrations were 68 and 38 mg/l, respectively.

Turbidity and Color

Turbidity in a raw water source is of concern in water treatment plants where the capacity must exist to remove the turbidity adequately, continuously and at a reasonable cost. A numerical standard for turbidity for the Little Miami River has not been established by the State of Ohio. However, the National Technical Advisory Committee on Water Quality Criteria has recommended a limit of 50 Jackson units for warm water streams and 10 Jackson units for cold water streams. For warm water lakes the recommended limit is 25 units and for cold water lakes the limit is 10 units. For primary contact recreational waters, the NTAC further recommends that a Secchi disc be visible at a minimum depth of four feet.

Most of the waters contained somewhat less than 25 Jackson turbidity units. With the exception of the last sampling station at the mouth of the Little Miami River, where turbidities averaged 26 and reached a maximum of 52 units, the average values ranged from about 10 to 20 Jackson turbidity units.

The State of Ohio has not established a numerical limit for color in the Little Miami River. However, it is recognized that color in excess of 50 units in the waters may limit photosynthesis and have a deleterious effect upon aquatic life, particularly the phytoplankton and

benthos. Color may also be a significant problem in water treatment operations or industrial processes. Color values averaged about 20 units in the main stem and tributaries. A minimum of ten units was observed in the headwaters and a maximum of 35 was observed at the mouth of the Little Miami River.

pH

The pH standard established by the State of Ohio states that the values are to be not less than 5.0 nor greater than 9.0 at any time. Any pH value within the range of 6.5 to 8.5 is considered desirable for aquatic life, water contact recreation, and public water supply. The pH values in the Little Miami River and tributaries ranged from 5.3 to 8.8. The maximum value of 8.8 was observed in the headwaters of the East Fork and the 5.3 minimum occurred in Gladys Run downstream from Xenia.

Arsenic and Cyanide

Standards for arsenic and cyanide have been established for the Little Miami River by the State of Ohio. Concentrations of 0.05 mg/l for arsenic and 0.025 mg/l for cyanide must not be exceeded at any time for waters to be used as a source for public water supply. For aquatic life, criteria must be based on a bioassay for each specific situation since other factors such as D.O., temperature, and pH greatly affect the toxic levels. The State of Ohio has established that concentrations of toxic substances in the streams must not exceed one-tenth of the 48-hour TL_m (Median Tolerance Limit). Concentrations of arsenic in the Little Miami River did not exceed the limit established; the values ranged between 0.03 mg/l and less than 0.01 mg/l. Concentrations of

cyanide were less than 0.01 mg/l at all stations in the Little Miami River and its tributaries.

Fluoride

A maximum allowable fluoride concentration of 1.0 mg/l has been set by the State for waters used as a source for public water supply. During the study the concentration of fluoride did not exceed this limit at any station; the concentrations ranged from 0.2 mg/l to 0.8 mg/l.

Cadmium, Chromium, Lead

Maximum allowable concentrations for cadmium, chromium (hexavalent) and lead have been established by the State for the Little Miami River. The following concentrations are not to be exceeded at any time for waters used for a public water supply:

<u>Constituent</u>	<u>Concentration(mg/l)</u>
Cadmium	0.01
Chromium (hexavalent)	0.05
Lead	0.05

For aquatic life, concentrations are not to exceed one-tenth of the 48-hour TL_m .

The cadmium concentrations at all stations in the Little Miami River and its tributaries were less than 0.01 mg/l. Concentrations of total chromium were less than 0.02 mg/l at all stations, which is less than the allowable limit of 0.05 mg/l for hexavalent chromium alone. Concentrations of lead were all less than the sensitivity of the analytical method used.

Iron, Manganese, Copper, Zinc, Oil, Phenol

Although the State of Ohio has not established standards for the following list of constituents, limits have been recommended by the National Technical Advisory Committee on Water Quality Criteria for waters used as a source of public water supply. The following table shows the recommended limit and the range observed at all sample stations during the study period:

<u>Constituent</u>	<u>Recommended Limit mg/l</u>	<u>Range Observed mg/l</u>
Iron	0.3	0.2 - 1.1
Manganese	0.05	0.03 - 0.22
Copper	1.0	0.00 - 0.06
Zinc	5	< 0.01 - 0.08
Oil	Absent	< 1 - 96
Phenol	0.001	0.005 - 0.010

For aquatic life, the National Technical Advisory Committee further recommends that concentrations of zinc and copper not exceed 1/100 and 1/10 of the 96-hour TL_m , respectively.

Oily substances may affect fish indirectly by coating algae and other plankton, removing a source of fish food, or directly by coating the gills, interfering with respiration. Oil and phenolic substances may also be ingested by fish, tainting their flesh.

Concentrations of copper and zinc were less than their respective limits at all stations. Iron concentrations exceeded the 0.3 mg/l

limit at all main stem and tributary stations with the exception of the reach on the East Fork between Batavia and Williamsburg (RM-11.8-32.7) where values of 0.3 or less were observed. Manganese, oil and phenol concentrations were greater than their respective limits at all stations.

Water quality criteria have not been established for numerous other constituents examined during the study. These include calcium, sodium, potassium, aluminum, nickel, total organic carbon, and chemical oxygen demand. Concentrations are summarized in Appendix A.

BIOLOGY

Because aquatic life spans range from several months to three years, benthic or bottom organisms are indicative of present and recent past water quality. In an unpolluted stream, many kinds of organisms can exist, but, because of competition for food and space, and predation, each kind is low in numbers of individual organisms. Clean water or pollution-sensitive invertebrates such as stoneflies, hellgrammites, mayflies, and riffle beetles usually are well represented in an unpolluted habitat, and provide food for desirable fishes. Nutrients added to a clean water habitat may produce an enriched condition. Enrichment results when increased quantities of fertilizing nutrients are added to the water and provide for an increased growth of natural foods that will support increased numbers of a wide variety of animals. When the increased rate of growth of natural foods is accompanied by a corresponding increase in numbers of animals capable of utilizing the food, the

natural foods cannot affect the physical and chemical environments of the stream. This stage of enrichment is desirable since an increased number of preferred fish food organisms are produced and an increase in desirable game fish occurs until the carrying capacity of the environment is reached.

As enrichment is increased, the rate of natural food production exceeds the assimilative capacity of the animals present and the excess natural foods begin to affect the chemical (increased rates of dissolved oxygen production and utilization, and calcium deposition) and physical (blanketing of animal habitats) properties of the stream.

Introduction of an organic pollutant into a stream affects the benthic organisms present depending upon the concentration of pollutant and the relative tolerance of the organisms. A slight amount of pollutant results in a decrease in kinds and numbers of pollution-sensitive organisms and an increase in numbers of these tolerant organisms that are able better to adjust to the environment and to utilize the pollutant as food.

As pollution increases to a moderate level, most or all pollution-sensitive organisms disappear and more tolerant organisms increase in number and occupy the areas formerly inhabited by the clean water organisms.

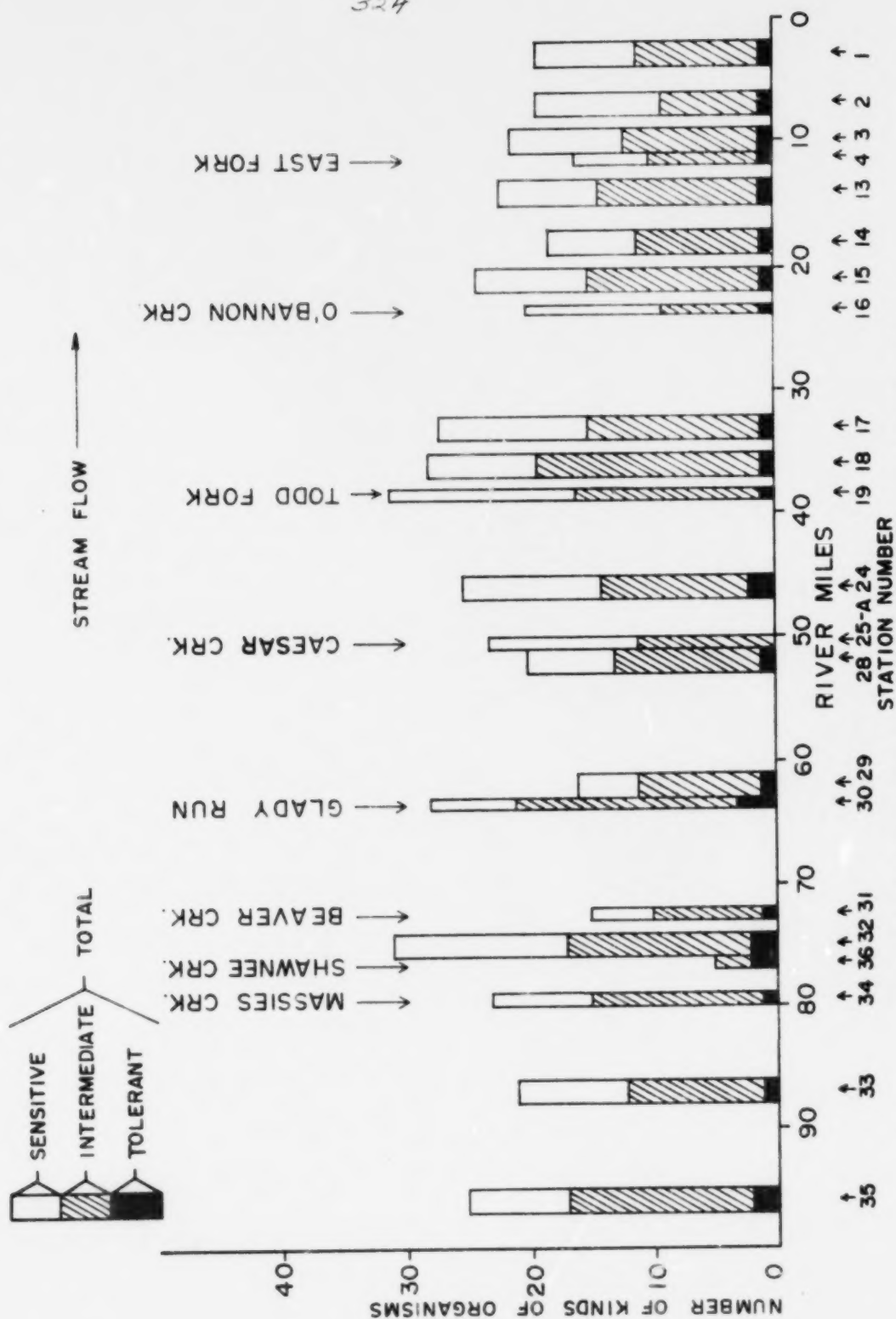
Excessive organic pollution eliminates clean water associated organisms and reduces in numbers those that are intermediately tolerant.

With reduced predation and competition, and having available a bountiful food supply, pollution-tolerant sludgeworms increase greatly in number in this environment. Where excessive quantities of organic wastes begin to decompose, dissolved oxygen is reduced or eliminated, toxic by-products of decomposition such as hydrogen sulfide are produced, and both kinds and numbers of organisms are reduced or may be entirely eliminated.

Little Miami River

The Little Miami River upstream from Clifton, Ohio (Station 35), supported 686 organisms per square foot with 25 kinds present in the samples collected. Clean water organisms were well represented, 100 per square foot, but pollution-tolerant sludgeworms were numerous (109 per square foot). Of the 476 intermediate organisms collected, midges and clams were predominant (Table 3-A). Composition of the benthic community indicated that the area was enriched, probably by nutrients from agricultural drainage. However, pollution-sensitive organisms were sufficient in number to support a desirable sport fishery.

Downstream from Clifton (Station 33), natural processes had assimilated enough of the nutrients to result in a reduction to 340 organisms per square foot. Clean water organisms numbered 59 per square foot. Silt deposited on the bottom supported 114 sludgeworms per square foot but the numbers of intermediate organisms had decreased to 166 per square foot. The stream reach supported a fauna typical of a naturally enriched but polluted area.



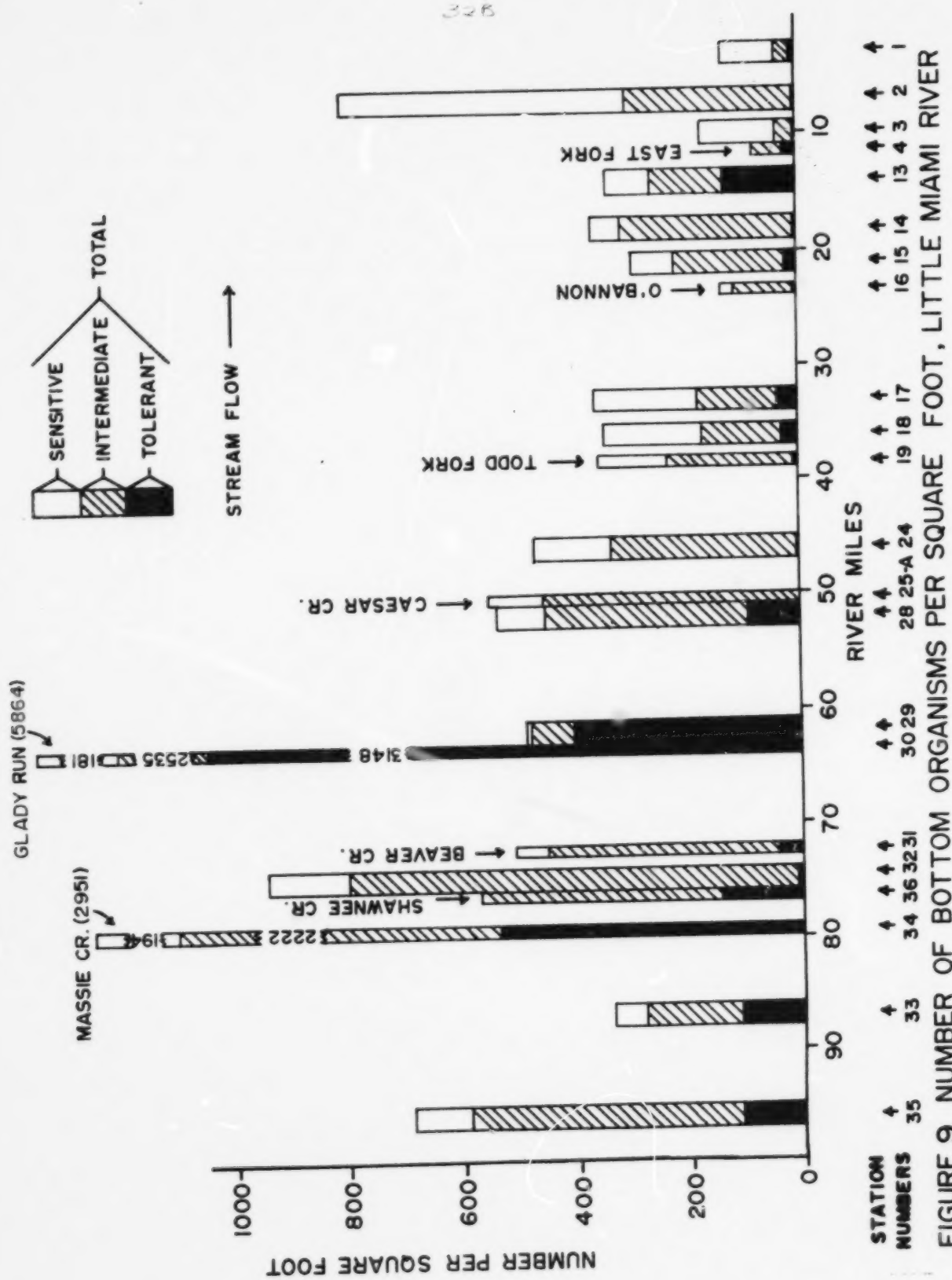


FIGURE 9. NUMBER OF BOTTOM ORGANISMS PER SQUARE FOOT, LITTLE MIAMI RIVER

Mascie Creek entered the river 6.1 miles downstream from Station 33 and supported 2,951 organisms per square foot at its mouth (Station 34), of which 535 were sludgeworms (Table 3-A). Midges were the most numerous of the 2,222 intermediate organisms per square foot present in the area. Sensitive organisms numbered 194 per square foot. Other than the high numbers of tolerant and intermediate organisms, there was no observable evidence of enrichment such as extensive periphyton (attached algae) growths. However, the benthic organisms present were typical of an unnatural community and indicative of the presence of organic nutrients in the stream.

Shawnee Creek discharges moderately polluted water from the Xenia area into the Little Miami (Station 36). The creek was gray in color and had the odor of sewage. The benthic community consisted of five kinds of organisms numbering 564 per square foot. No sensitive organisms were present and blackflies were predominant among the intermediate organisms. Pollution-tolerant sludgeworms numbered 101 per square foot.

In the Little Miami River upstream from the confluence with Beaver Creek (Station 32), the effects of Shawnee Creek were evident for a distance of about one mile (Figures 8 and 9). A total of 937 organisms per square foot were collected. Midges, numbering over 600 per square foot, were predominant in the area, but pollution-sensitive stoneflies, mayflies and caddisflies were also present. The high number of intermediate organisms was indicative of an unnatural community associated with the enriched pollution recovery zone of a stream.

Beaver Creek (Station 31, Figure 1-A) was enriched, apparently by agricultural drainage. No known sources of domestic wastes discharge to the stream. The stream bed, covered with mats of periphyton and rooted aquatic vegetation, supported 502 organisms per square foot. Sensitive and pollution-tolerant organisms were smaller in number than intermediate organisms, an indication of an unbalanced community (Figure 9 and Table 3-A). Midges, blackflies and isopods were present on rocks on the bottom. The benthic community was typical of an enriched situation.

Glady Run (Station 30) flowing into the Little Miami upstream from Spring Valley was slightly polluted. The benthic community consisted of 5,864 organisms per square foot of which 3,136 were sludge-worms. Midges, isopods and scuds were numerous (Table 3-A).

With the polluted water of Glady Run entering the Little Miami, the river downstream from Spring Valley (Station 29) supported a benthic community typical of a slightly polluted zone; 16 kinds of benthic organisms averaging 481 per square foot were collected (Figure 9). Sludge-worms, with a population of 400 per square foot, comprised the majority of the bottom organisms. Downstream 12.1 miles (Station 28), water quality in the Little Miami improved. Twenty kinds of organisms were present at a density of 536 per square foot. Sludgeworm numbers were reduced to 94 per square foot. Sensitive and intermediate organisms numbered 87 and 355 per square foot, respectively, which is sufficient to support desirable game fish. Farther downstream (Station 24), the Little Miami had recovered from the effects of organic pollution

introduced upstream. The stream supported 25 kinds of organisms totaling 468 per square foot (Figures 8 and 9). Caddisflies and mayflies were abundant (Table 3-A).

The Little Miami from Morrow, Ohio (Station 18), to South Lebanon (Station 17) (Figure 1-A) was unpolluted as indicated by bottom organisms. Twenty-eight and 27 kinds of benthic organisms numbering 342 and 359 per square foot, respectively, were present at these stations. A slightly turbid water supported a total of 165 and 180 preferred fish food organisms per square foot such as stoneflies, mayflies, caddisflies, and riffle beetles (Tables 8 and 9). The benthic communities were indicative of a clean water environment.

O'Bannon Creek enters the Little Miami at mile point 23.6 (Station 16) (Figure 1-A). The creek supported 20 kinds of organisms numbering 137 per square foot. Stoneflies were predominant of the sensitive organisms present and pollution-tolerant organisms were low in number; this indicated acceptable water quality for aquatic life.

Samples of the benthic community downstream from Loveland (Station 15) contained 287 organisms per square foot and 24 kinds. Midges were predominant in the benthic community. Pollution-sensitive fish food organisms were low in number, 70 per square foot, but the stream reach should be capable of supporting a recreational fishery. The total benthic community was one which would be expected to be found in enriched waters.

Approximately four miles downstream from Station 15, the Little Miami near Miamiville supported a benthic community typical of enriched environment (Station 14). Midges were predominant. Mayflies and caddisflies were numerous, while pollution-tolerant organisms were not (Table 2-A).

Downstream from Milford and upstream from its confluence with the East Fork, the Little Miami River supported 22 kinds of invertebrates numbering 337 per square foot (Station 13). Snails and sludgeworms were predominant in the area, characteristics of a slightly polluted environment. Pollution-sensitive mayflies and caddisflies were present but not numerous (Table 2-A).

Two miles downstream from Milford (Station 3), the river's water quality was improved. Twenty-one kinds of organisms numbering 165 per square foot were collected. Sludgeworms were reduced from 125 upstream near Milford to one per square foot in this reach. Sensitive organisms numbered 130 per square foot. Mayflies and caddisflies were numerous. Small-mouth bass were noted in this reach indicating that the stream was able to support desirable fishes.

Evidence of enrichment was noted in the stream near Newtown (Station 2). Invertebrates numbered 794 per square foot. Sensitive organisms numbered 495 per square foot with caddisflies being predominant. Blackflies comprised the majority of the intermediate organisms; 252 organisms per square foot were found.

Three and a half miles upstream from the confluence of the Little Miami River with the Ohio River the stream appeared to be enriched. Rocks on the bottom had black undersides, an indication of decomposing organic materials and a sludge bed was noted at the mouth of Duck Creek located just upstream from the sampling station. However, the benthic community was composed of moderate numbers of mayflies, riffle beetles, and midges, an indication of fair quality water. An improved quality of water would have supported larger numbers of pollution-sensitive stoneflies, mayflies and caddisflies. Water flowing from the Little Miami to the Ohio was enriched at this point.

Caesars Creek

Caesars Creek flows into the Little Miami downstream from Station 28 at River Mile 51.0 (Figure 1-A). The stream had clear water flowing over small rocks and coarse gravel at the upstream sampling station (Station 27). Agricultural drainage provided sufficient nutrients to support 170 sludgeworms per square foot, which were the predominant organisms present. Stoneflies and mayflies, although present, were not numerous (Table 3-A).

Anderson Fork, flowing into Caesars Creek (Station 26) had a low number of organisms (Figure 10). The slow moving clear water supported stoneflies, mayflies, and caddisflies, an indication of clean water conditions.

Caesars Creek downstream from Harveysburg received some enrichment (Station 25). The effects of this enrichment were primarily nutritional

and resulted in an increase of sensitive and intermediate organisms to 628 and 768 per square foot, respectively, and tolerant organisms to only 40 per square foot.

At the mouth of Caesars Creek the stream water was good quality. Both the number of organisms and number of kinds were high (Figures 10 and 11). Pollution-sensitive stoneflies, mayflies, hellgrammites and caddisflies were present in the area sampled, an indication of clean water.

Todd Fork

Todd Fork in its headwaters supported a diverse benthic community of 29 kinds of organisms numbering 378 per square foot. Algal streamers in the riffle areas were one to two feet in length and intermediate organisms were predominant, an indication of abundant nutrients in the water. The low number of tolerant organisms was an indication that enrichment was not severe.

Lytle Creek added nutrient-rich waters to Todd Fork as evidenced by the 2,046 organisms per square foot present at Station 22 (Figure 10). Intermediate organisms numbered 1,965 per square foot. Water in the creek was clear, but the undersides of rocks were black in color, an indication of decomposing material. Algae covered the stream bottom and large numbers of rough fish were observed in the area. Lytle Creek was slightly polluted at its mouth.

Cowan Creek, flowing into Todd Fork downstream from the confluence of Todd Fork with Lytle Creek, was enriched. Blackflies numbering 202

384

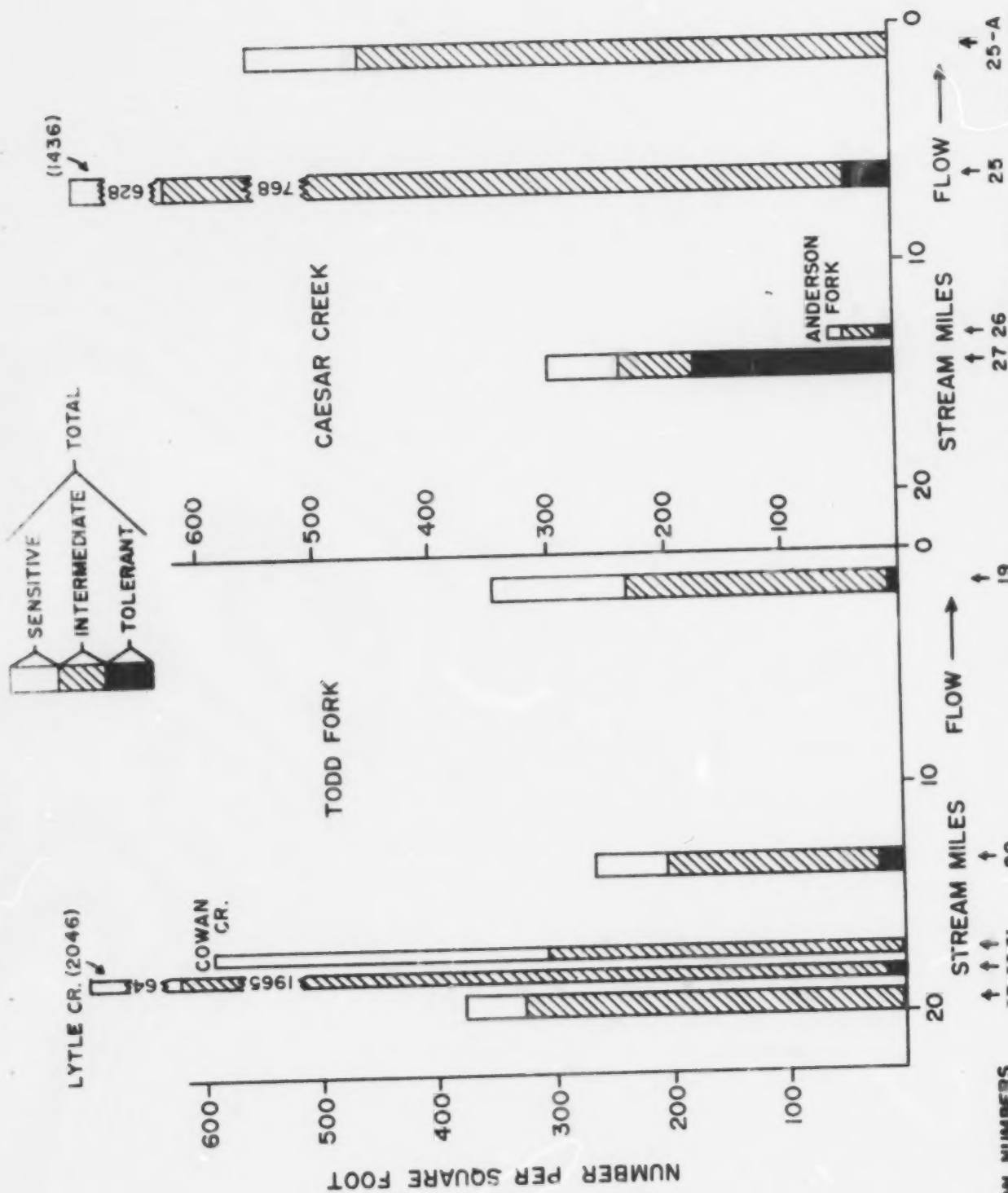


FIGURE 10. NUMBER OF ORGANISMS PER SQUARE FOOT, TODD FORK AND CAESAR CREEK

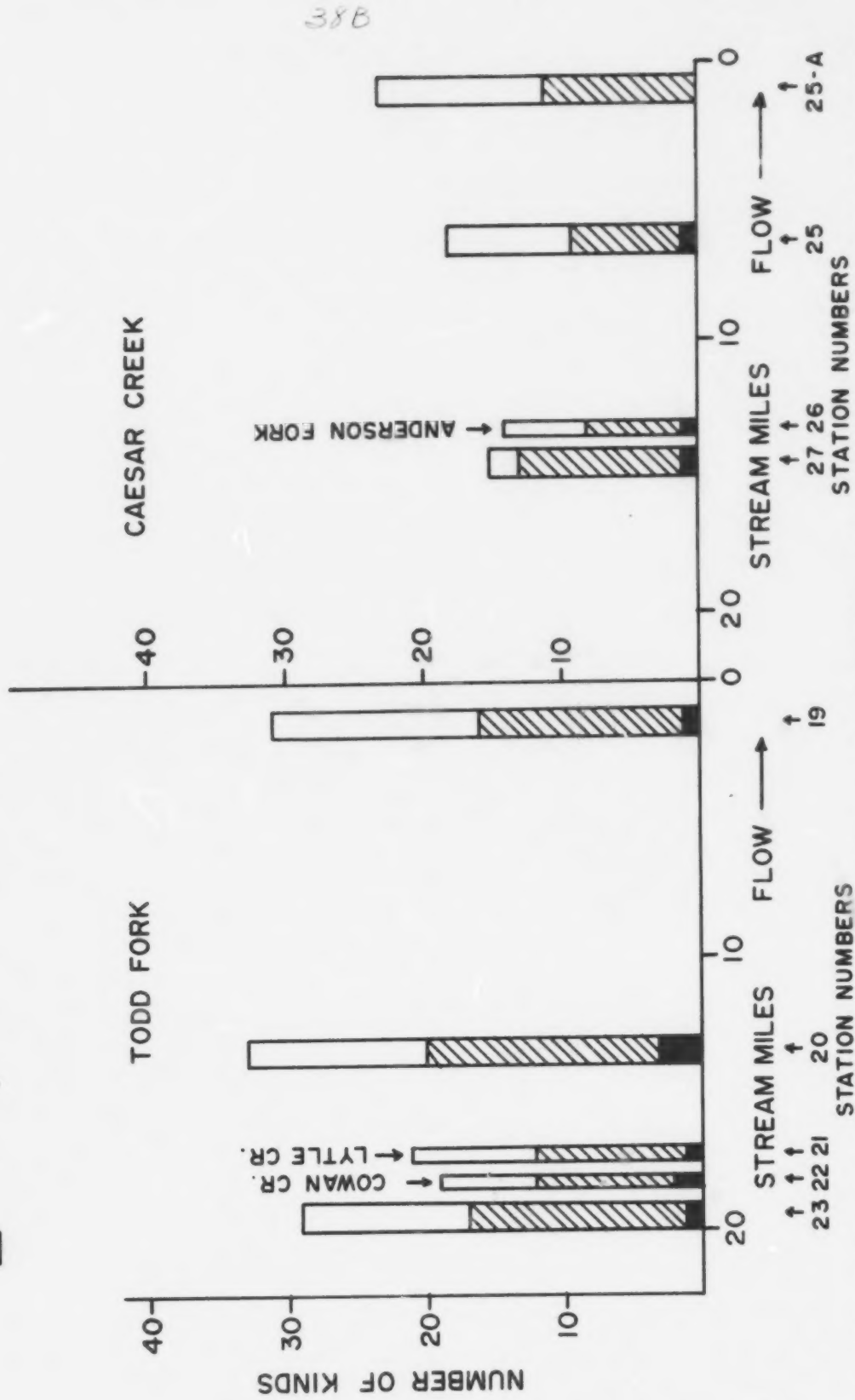
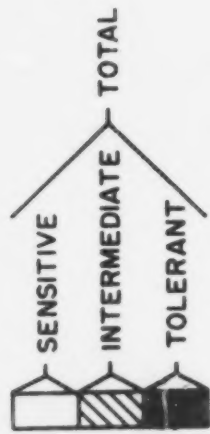


FIGURE II. NUMBER OF KINDS OF BOTTOM ORGANISMS, TODD FORK AND CAESAR CREEK

per square foot were predominant in the stream indicating conditions favorable to these intermediate organisms. However, the creek supported 592 organisms per square foot, 285 per square foot being pollution-sensitive.

Downstream from Clarksville, Todd Fork was improved. A diverse benthic community of 33 kinds numbering 263 organisms per square foot indicated the stream was in good condition (Figures 10 and 11). Near the confluence of Todd Fork with the Little Miami, the stream supported stoneflies, hellgrammites, mayflies, caddisflies, and riffle beetles numbering 114 per square foot. Total number of kinds of invertebrates collected was 31. Water from Todd Fork was not degraded for aquatic life when it entered the Little Miami.

East Fork

The East Fork of the Little Miami was surveyed from its confluence to a point upstream from Lynchburg, Ohio (Stations 4 through 12)(Figure 1-A). At Station 12 (River Mile 74.1) water in the stream was clear and 27 kinds of benthic invertebrates numbering 400 per square foot were present (Table 2-A). Abundant growths of periphyton covered the bottom of the stream and were probably supported by the introduction of nutrients from agricultural drainage. Such nutrients produced conditions favorable to intermediate and tolerant benthic organisms resulting in larger numbers compared to the more sensitive kinds. However, because of the diversity of organisms present, the stream appeared to be in good condition and capable of supporting adequate populations of desirable fish.

Downstream from Lynchburg (Station 11, River Mile 70.9) a wide variety of benthic invertebrates was collected, 36 kinds numbering 337 per square foot. Pollution-sensitive stoneflies, mayflies, caddisflies, and riffle beetles were present; all were suitable fish food organisms. This reach of stream was satisfactory for production of aquatic life.

At Station 10 (River Mile 54.7) downstream from Fayetteville, sensitive organisms, predominantly riffle beetles, numbered 149 per square foot. A silty bottom provided suitable habitat for a moderate number of sludgeworms. However, the number of sensitive organisms present in this reach indicated the stream was not affected by pollution.

A decrease in the number of organisms downstream from Williamsburg, compared to those upstream (Stations 8 and 9)(Figures 12 and 13), was probably due to the presence of a small impoundment upstream from sampling Station 6. The impoundment reduced the velocity of stream flow and six to ten inches of silt had covered the bottom. The presence of 12 sensitive and 12 intermediate kinds of benthic organisms numbering 26 and 27 per square foot, respectively, (Table 2-A) was an indication that the stream was not degraded for aquatic life.

Clean water conditions existed 17.5 miles downstream at Station 7 (River Mile 15.5), upstream from Batavia. Thirty-one different kinds of bottom organisms totaling 128 per square foot were found at this station. The benthic community contained a number of blackflies, 26 per square

foot, reflecting some enrichment, but the presence of stoneflies, mayflies, and caddisflies indicated that water quality was good.

The river downstream from Batavia (Station 6, River Mile 9.4) had 21 kinds of organisms numbering 122 per square foot. Benthic organisms sensitive to pollution were reduced from 16 kinds upstream from Batavia to six kinds downstream. Pollution-sensitive stoneflies, mayflies, and caddisflies were low in numbers. Snails, clams, and sludgeworms were the most abundant organisms in the area sampled. The benthic community was characteristic of a slightly polluted stream.

Between Batavia and the confluence of the East Fork with the Little Miami, Stonelick Creek enters the stream (Station 5, Figure 1-A). Water in Stonelick Creek was clear and swift flowing. The benthic community was diverse with 17 of the 30 kinds of organisms present being sensitive to pollution. The water quality was unsuitable for aquatic life near its confluence.

The East Fork one mile upstream from its confluence with the Little Miami was a slow-moving, silty stream. Bottom muds were oily in appearance and odor, and gray in color, indicative of organic pollution. The benthic community was characteristic of a slightly polluted area with low numbers of mayflies, caddisflies, and beetles (Table 2-A). This stream reach had the lowest number of kinds of organisms as well as the lowest total number of organisms compared to the other stations sampled in the East Fork subbasin (Figures 12 and 13).

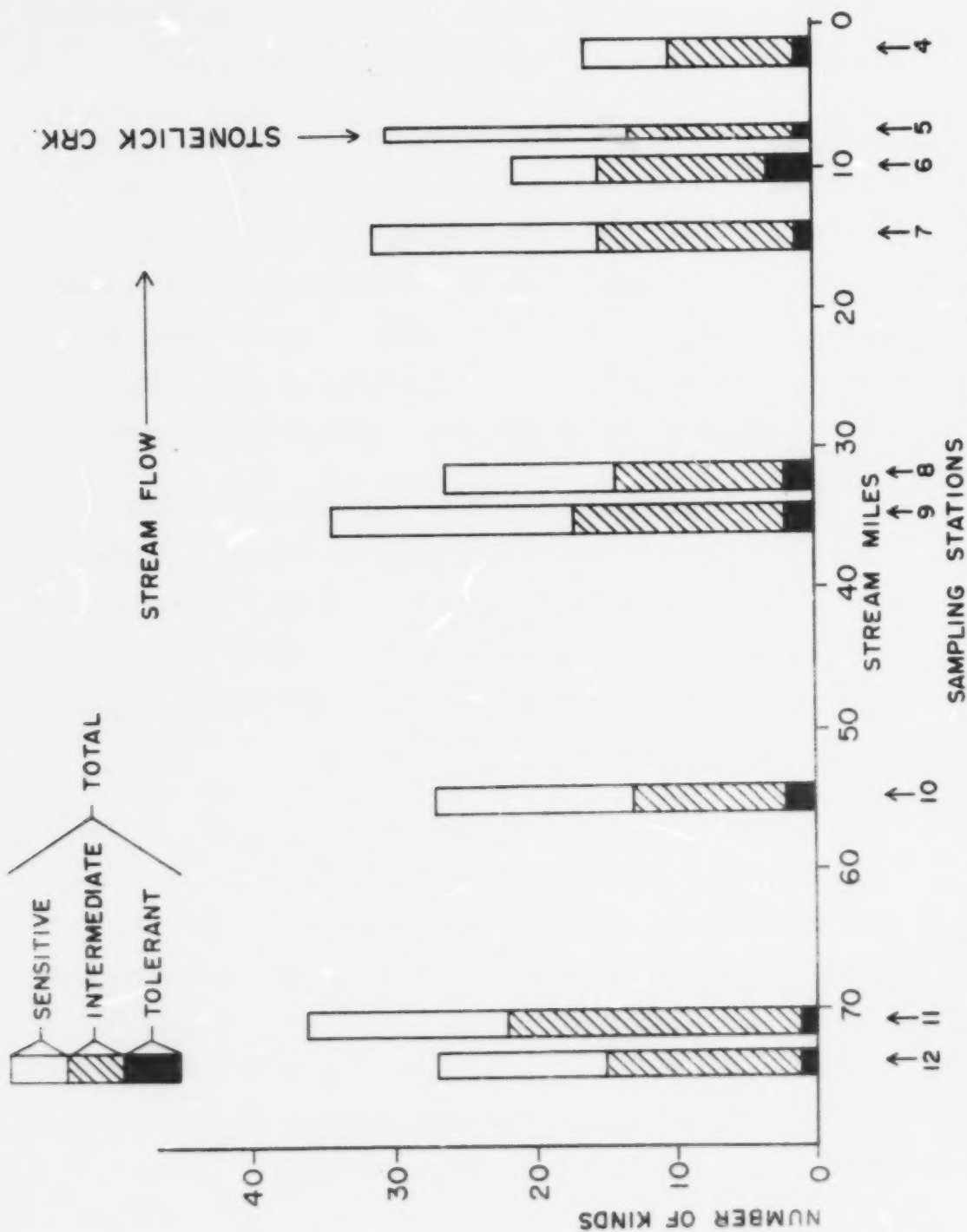


FIGURE 12. NUMBER OF KINDS OF BOTTOM ORGANISMS
EAST FORK, LITTLE MIAMI RIVER, APRIL - MAY 1968

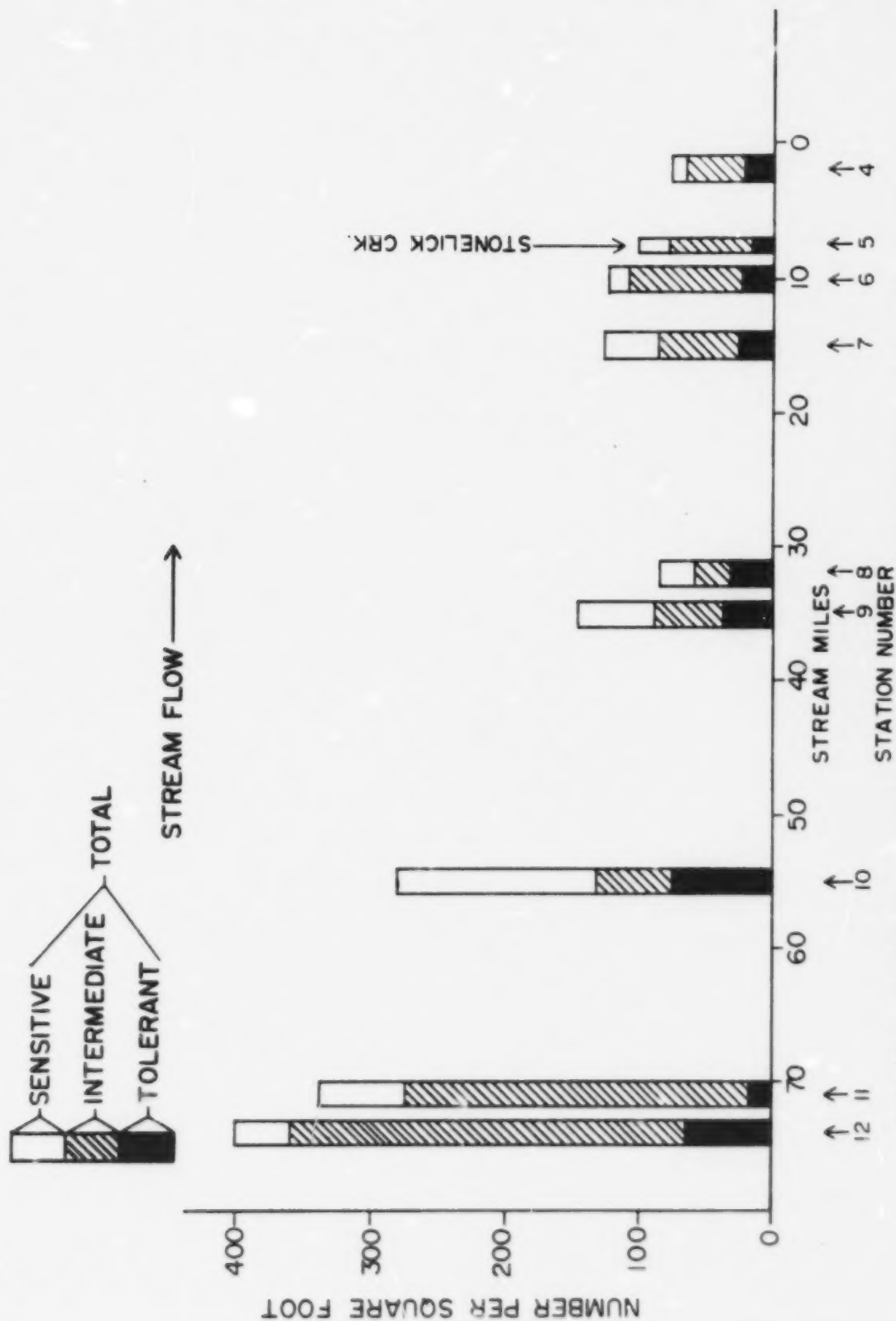


FIGURE 13. NUMBER OF BOTTOM ORGANISMS PER SQUARE FOOT, EAST FORK LITTLE MIAMI RIVER APRIL-MAY 1968.

APPENDIX A

APPENDIX A

TABLE 1-A

REFERENCE POINT LOCATIONS

Little Miami River

<u>STATION NO.</u>	<u>DESCRIPTION</u>	<u>MILEAGE FROM MOUTH</u>
	Mouth Little Miami River	0
1	Beechmont Bridge	3.4
	Duck Creek Enters	3.8
2	Newtown Road Bridge	7.8
3	Roundbottom Rd. across from Terrace Park	10.4
	East Fork Little Miami Enters	11.1
4	Co. Rd. 113 Bridge East Fk. Lt. Miami	11.1-0.7
	Stonelick Creek Enters	11.1-8.6
5	U. S. 50 Bridge, Stonelick Cr.	11.1-8.6-1.0
6	Ohio 222 Bridge, E. Fk. Lt. Miami	11.1-11.8
	Batavia STP	13.2
7	Ohio 222 Bridge, E. Fk. Lt. Miami	11.1-15.5
	Cloverlick Creek Enters	11.1-27.0
8	Co. Rd. 131 Bridge near Ohio 32	11.1-32.7
	Williamsburg	
9	Co. Rd. 80 Bridge	11.1-35.8
10	Ohio 131 Bridge	11.1-54.7
	Fayetteville	
11	Co. Rd. T-120 Bridge near U.S. 50	11.1-70.9
	Lynchburg STP	
12	From Ohio 134 Upstream from Lynchburg	11.1-74.1

TABLE 1-A (Contd.)
REFERENCE POINT LOCATIONS
Little Miami River

<u>STATION NO.</u>	<u>DESCRIPTION</u>	<u>MILEAGE FROM MOUTH</u>
13	Milford Bridge, U. S. 50	12.7
	Milford S.T.P.	13.3
14	By Pass 50 & Ohio 126 near Miamiville	17.6
15	Branch Hill - Guinea Pike Bridge	21.1
	O'Bannon Creek Enters	23.6
16	Hutchinson Rd. Br., O'Bannon Cr.	23.6-2.0
17	Ohio 48 Bridge near So. Lebanon	33.1
18	Stubbs Rd. Bridge off U.S. 22 & Ohio 3	35.8
	Todd Fork Enters	38.4
19	Blackhawk Rd. Br., Todd Fk.	38.4-1.8
20	Ohio 350 Bridge, Todd Fk.	38.4-14.4
	Cowan Creek Enters	38.4-17.0
21	Co. Rd. T-35 Br., Cowan Cr.	38.4-17.0-0.5
	Lytle Creek Enters	38.4-18.5
22	Co. Rd. T-35 - Clarksville Rd. Br.	38.4-18.5-0.6
23	U.S. 22 & Ohio 3 Bridge, Todd Fk.	38.4-19.5
24	Wilmington Rd. Br. near I-71	45.7
	Caesar Creek Enters	51.0
25-A	Mouth of Caesar Cr., Corwin Rd. Br.	51.0-0.2
25	Middletown Rd. Br., Caesar Cr.	51.0-6.2
	Anderson Fork Enters	51.0-13.7

TABLE 1-A (Contd.)
 REFERENCE POINT LOCATIONS
 Little Miami River

<u>STATION NO.</u>	<u>DESCRIPTION</u>	<u>MILEAGE FROM MOUTH</u>
26	Ohio 380 Br., Anderson Fk.	51.0-13.7-0.2
27	Ohio 380 Br., Caesar Cr.	51.0-18.3
28	Waynesville-Corwin Rd. Br.	51.3
29	U.S. 42 Bridge downstream from Spring Valley	63.4
	Glady Run Enters	63.7
30	Co. Rd. 144 Br., Glady Run	63.7-1.1
	Beaver Creek Enters	72.6
31	Old U.S. 35 Br., Beaver Cr.	72.6-1.8
32	Old U.S. 35 at Trebein	75.8
	Shawnee Creek Enters	76.7
36	Ohio 380 Br. near Xenia, Shawnee Cr.	76.7-0.1
	Massie Creek Enters	79.9
34	U.S. 68 Br. near Trebein, Massie Cr.	79.9-0.2
33	Near Ohio 343, downstream from Clifton	88.5
	North Fork Little Miami River	92.1
35	Selma Pike Br. upstream from Clifton	95.6

44A

FIGURE 1-A
 DETAIL MAP
 LITTLE MIAMI RIVER STUDY
 OHIO



TABLE 2-A
 SENSITIVE ORGANISMS COLLECTED AT STATIONS 1 - 17
 APRIL - MAY 1968
 Little Miami River Basin

Sensitive Organisms

Tributaries				East Fork										O'Beannon Creek			
River Mile	5.4	7.0	10.4	6.7	8.6-1.0	9.4	10.3	12.7	14.1	14.7	16.9	17.1	17.7	17.6	21.1	25.6-2.0	33.1
Station No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Stoneflies (Plecoptera)																	
Isoperla	-	-	-	-	Q	-	Q	Q	1	1	1	7	-	-	-	1	1
Acroneuria	-	-	-	-	1	Q	2	Q	10	8	8	8	-	Q	Q	11	1
Rhyacura	-	-	-	-	Q	-	Q	-	Q	1	-	-	-	-	-	Q	-
Leuctra	-	-	-	-	Q	-	-	-	-	-	-	-	-	-	-	-	-
Mayflies (Ephemeroptera)																	
Caenis	Q	1	1	3	Q	3	1	Q	3	-	Q	Q	Q	-	-	-	1
Stenonema	8	30	15	3	3	1	2	5	5	2	1	1	Q	22	12	Q	46
Heptagenia	2	-	2	-	1	-	1	1	1	-	1	-	-	-	1	3	-
Ephemerella	-	-	-	-	1	-	1	-	1	-	-	-	-	-	-	-	-
Paraleptophlebia	-	-	-	-	Q	-	-	-	-	-	-	-	-	-	-	1	-
Cinygmula	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Heatis	61	76	18	Q	Q	-	5	Q	Q	16	13	10	1	-	1	1	23
Ephemerella	-	-	-	-	-	-	-	1	Q	Q	Q	-	-	-	-	-	-
Isaia	-	-	-	-	-	-	-	-	Q	-	-	Q	-	-	-	-	-
Caddisflies (Trichoptera)																	
Chamaetypus	Q	261	69	1	Q	5	Q	Q	Q	10	2	1	Q	9	32	-	40
Hydropsyche	Q	114	9	-	-	-	Q	-	-	Q	6	-	1	2	19	-	59
Orthotrichia	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-
Agryllus	-	-	-	-	-	Q	-	-	1	-	1	1	Q	15	1	Q	1
Chimarra	-	-	-	-	-	-	Q	-	-	1	1	3	-	-	-	-	1
Psychomyia	-	-	-	-	-	-	-	-	Q	-	-	1	-	-	Q	Q	2
Hydroptila	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Atherisporus	-	-	-	-	-	-	-	-	Q	Q	-	-	-	-	-	-	-
Wormella	-	-	-	-	Q	-	-	-	-	-	-	-	-	-	-	-	-
Polysentropus	-	-	-	-	Q	-	Q	-	-	-	-	-	-	-	-	-	-
Ptilostomis	-	-	Q	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beetles (Coleoptera)																	
Cylloepus	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baropus	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
Hydroscopus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Odontophila	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Stenelmis	11	11	14	1	1	1	8	5	18	101	26	9	62	1	1	-	4
Psephenus	-	1	1	-	1	-	11	7	3	Q	1	Q	1	-	-	1	1
Ascyrtus	-	-	-	-	-	-	-	-	-	-	-	-	-	Q	-	-	-
Phytobius	-	Q	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Helgrammites (Megaloptera)																	
Corydalis	-	-	-	-	-	-	Q	-	-	-	-	-	-	-	-	-	-
Aquatic Moths (Lepidoptera)																	
Elaphia	-	1	-	-	-	-	-	-	-	Q	-	-	-	-	-	-	-
Clams (Pelecypoda)																	
Unionidae	-	-	-	-	-	-	1	Q	-	-	-	-	-	-	-	-	-
Subtotal - No./sq. ft.	90	495	130	10	22	15	42	26	55	149	63	42	78	51	70	23	180
Subtotal - Kinds	8	10	9	6	17	6	16	12	17	14	14	12	8	7	9	11	18

Q = Organisms not collected quantitatively, arbitrarily given value of one for computing.

TABLE 2-A (contd.)
 BENTHIC ORGANISMS COLLECTED AT STATIONS 1 - 17
 APRIL - MAY 1968
 Little Miami River Basin
 Intermediate Organisms

Tributaries				East Fork										D'Baron Creek			
River Mile	5.4	7.0	10.4	0.7-1.0	0.6-1.0	0.4	15.5	32.7	35.0	44.7	70.3	74.1	14.7	17.0	21.1	25.6-2.0	35.1
Station No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Damselflies (Zygoptera)																	
Agrion	-	-	-	-	-	-	-	-	-	-	Q	Q	-	-	-	-	Q
Asphaerion	-	-	Q	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Argia	Q	-	1	-	-	-	Q	1	Q	-	-	-	-	Q	Q	Q	Q
Stoneflies (Trichoptera)																	
Tipula	1	-	-	-	Q	-	1	-	-	1	-	Q	1	-	-	-	1
Limonophila	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Pilaria	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Hemiptera	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Dragon Flies (Anisoptera)																	
Boyeria	-	-	-	-	-	-	-	-	-	-	Q	-	-	-	-	-	-
Black Flies (Simuliidae)																	
Simulium	-	252	-	-	Q	1	26	1	2	15	22	1	4	19	15	Q	4
Prosimulium	-	-	-	-	-	-	-	-	-	-	-	-	12	-	2	Q	1
Biting Midges (Ceratopogonidae)																	
Hexia	-	-	-	1	-	-	-	-	-	4	Q	-	-	-	-	-	-
Midges (Tendipedidae)																	
Hemiteles	Q	Q	Q	1	42	3	4	1	1	Q	195	237	40	234	102	8	65
Pantaneura	3	Q	1	Q	Q	1	1	1	1	-	Q	1	1	1	1	-	7
Thaumatococcus	6	9	11	13	-	4	-	-	1	-	Q	-	-	-	6	-	4
Polypedilum	9	16	4	Q	Q	-	1	Q	4	20	1	4	10	21	43	1	45
Paratendipes	-	-	-	-	1	8	-	-	1	-	5	-	-	-	-	1	1
Cryptochironomus	-	-	-	-	-	-	1	-	1	1	Q	-	1	-	-	-	2
Cricotopus	Q	17	1	4	-	-	1	-	1	-	-	-	-	24	14	-	-
Metriocnemus	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chironomus	1	-	1	1	10	Q	-	1	Q	Q	2	3	4	Q	1	-	-
Microtendipes	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-
Psephenellinae	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tanytarsus	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Cardiocladius	Q	Q	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Calopterygidae	-	-	Q	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beetles (Amphipoda)																	
Hyalella	-	-	-	-	-	9	-	5	Q	-	1	-	-	-	-	-	-
Gammarus	-	-	-	Q	-	-	-	-	-	-	Q	Q	-	-	Q	-	-
Hyalella	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Isopoda																	
Asellus	-	-	-	-	3	-	1	-	-	-	-	-	-	-	-	-	-
Liriodora	-	-	-	Q	Q	-	Q	1	1	1	1	6	Q	-	Q	4	1
Amphipoda (Rhipididae)																	
Crayfish	-	-	Q	-	1	Q	Q	1	Q	Q	1	-	1	Q	3	-	1
Mollusks (Gastropoda)																	
Limulus	-	Q	-	-	1	35	14	Q	1	4	1	Q	54	2	6	1	8
Class (Pelecypoda)																	
Sphaeriidae	-	-	-	-	-	20	7	12	34	7	17	34	1	-	-	-	-
Planaria	-	-	-	-	-	1	-	-	-	-	1	1	4	-	Q	-	-
Subtotal No./sq. ft.																	
	25	298	34	44	54	85	61	27	52	56	257	295	134	107	197	108	142
Subtotal Kinds																	
	10	8	11	9	12	12	14	12	15	11	21	14	13	10	14	8	14

Q = Organisms not collected quantitatively, arbitrarily given value of one for computing.

Reproduced from
 best available copy.

TABLE 2-A (Contd.)
BENTHIC ORGANISMS COLLECTED AT STATIONS 1 - 17
APRIL - MAY 1968
Little Miami River Basin

Tolerant Organisms

Tributaries		East Fork															O'Bannon Creek	
River Mile		3.4	7.8	10.4	0.7	8.6-1.0	9.4	15.5	32.7	35.8	54.7	70.9	74.1	12.7	17.6	21.1	23.6-2.0	33.1
Station No.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Snails (Pelecypoda)																		
Physa	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Roundworms (Nematodes)	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-
Leeches (Hirudinea)	-	-	-	-	-	-	1	-	Q	1	Q	-	-	-	-	-	Q	-
Sludgeworms (Oligochaeta)	13	1	1	1	21	15	20	25	30	36	74	16	63	125	2	19	6	37
Subtotal No./Sq. Ft.	13	1	1	1	21	15	22	25	31	37	75	17	63	125	2	20	6	37
Subtotal Kinds	1	1	1	1	1	1	3	1	2	2	2	1	1	1	1	1	1	1

Grand Total No./Sq. Ft.	130	794	165	75	101	122	128	84	144	280	337	400	337	337	360	287	137	359
Number of Kinds	19	19	21	16	30	21	31	26	34	27	36	27	22	22	18	24	20	27

Q = Organisms not collected quantitatively, arbitrarily given value of one for computing.

TABLE 4-A
BENTHIC ORGANISMS COLLECTED AT STATIONS 18 - 36
APRIL - MAY 1968
Little Miami River Basin
Sensitive Organisms

Tributaries		Todd Fork							Caesar Creek							Gladys Run	Beaver Creek		Massie Creek		Shawnee Creek
River Mile	59.8	1.8	14.4	17.0-0.5	18.5-0.6	19.5	45.7	0.2	6.2	13.7-0.2	14.0	11.5	65.4	65.7-1.1	76.6-1.5	75.8	86.0	77.9-0.2	95.8	76.7-0.1	
Station No.	18	19	20	21	22	23	24	25A	25	26	27	28	29	30	31	32	33	34	35	36	
Stoneflies (Plecoptera)																					
Isoperla	-	1	Q	1	Q	Q	-	1	-	-	-	-	Q	-	5	1	-	-	-	-	
Acroneuria	5	8	1	27	-	1	1	1	8	1	2	-	-	-	18	5	8	Q	8	-	
Amblyura	1	2	-	Q	-	Q	-	Q	-	-	-	-	Q	Q	-	Q	-	1	-	-	
Neophaaganophora	-	-	-	-	-	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	
Taeniopteryx	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	
Mayflies (Ephemeroptera)																					
Caenis	-	1	5	-	5	9	-	-	-	1	-	-	-	-	-	1	4	-	-	-	
Ectonema	27	4	Q	1	Q	5	56	2	120	1	Q	56	Q	Q	-	46	6	Q	5	-	
Heptagenia	-	-	-	1	-	-	1	4	-	-	-	-	-	-	-	-	-	-	-	-	
Ephemerella	-	-	1	-	-	-	-	-	4	1	Q	-	-	-	-	-	15	-	-	-	
Paraleptophlebia	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	
Heptagenia	9	14	8	22	6	2	15	14	24	-	12	2	Q	50	28	16	6	53	15	-	
Ephemerella	-	-	-	-	-	-	-	-	-	-	-	-	Q	-	-	Q	-	-	-	-	
Leuctra	-	-	Q	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	
Pseudocloeon	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	
Caddisflies (Trichoptera)																					
Chumatopsyche	56	12	19	-	-	1	56	13	64	1	20	21	-	49	4	6	5	20	15	-	
Hydropsyche	48	7	15	-	-	-	56	4	8	-	5	5	-	56	-	11	-	6	-	-	
Agrus	-	1	-	-	-	1	-	-	-	-	-	-	-	11	-	-	-	-	4	-	
Chimarra	5	12	-	-	-	-	1	17	44	-	-	-	-	-	-	-	-	-	-	-	
Psychomyia	-	1	-	-	-	1	-	-	-	-	-	Q	-	-	-	1	-	-	-	-	
Hydropsyche	-	-	-	16	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Helicopsyche	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Lepidostoma	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	27	7	-	1	-	
Polycentropus	-	Q	-	-	-	-	Q	-	-	-	-	-	-	-	-	-	-	-	-	-	
Beetles (Coleoptera)																					
Ordoctreva	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	
Amblyura	-	-	-	-	-	-	-	-	-	-	-	-	-	11	Q	-	-	-	-	-	
Stenelmis	15	45	8	56	53	5	7	25	944	8	5	25	-	-	-	-	16	78	51	-	
Peperatus	5	4	4	0	11	55	-	-	12	-	-	1	-	-	-	8	2	26	15	-	
Hellgrammites (Megaloptera)																					
Corydalis	-	Q	Q	-	-	-	Q	Q	-	-	1	-	-	-	-	-	Q	-	-	-	
Aquatic Moths (Lepidoptera)																					
Elaphila	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Subtotal No./Sq. Ft.	169	114	62	88	64	80	154	9	628	15	60	67	1	171	94	150	59	174	100	0	
Subtotal Kinds	9	15	13	1	7	12	11	12	9	6	2	7	2	7	5	14	10	6	8	0	

Q = Organisms not collected quantitatively, arbitrarily given value of one for computing.

Q = Organisms not collected quantitatively, arbitrarily given value of one for comparison

TABLE 1-A LITTLE MIAMI RIVER SYSTEM

Water Temperature, °C

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	24.0	27.0	20.0	19	13.0		
2	24.2	27.0	20.0	20	12.5		
3	24.3	27.5	19.5	21	16.0		
4	21.8	27.0	20.0	22	16.0		
5	18.0			23	16.0		
6	24.6	27.0	20.0	24	12.5		
7	24.2	26.5	20.0	25	13.5		
8	24.4	26.5	19.0	25-A	10.5		51
9	24.0	26.0	19.0	26	16.5		
10	16.0			27	14.0		
11	17.5			28	11.5		
12	16.0			29	15.5		
13	24.0	26.0	20.0	30	18.0	21.0	15.0
14	23.0	26.0	19.0	31	11.0		
15	23.0	25.0	19.0	32	11.5		
16	12.5			33	14.5		
17	22.0	25.0	18.0	34	13.5		
18	23.0	25.0	18.0	35	16.0		

TABLE 1-1 LITTLE MIAMI RIVER SYSTEM

Dissolved Oxygen, mg/l

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	> 9.8	> 15.0	6.0	19	13.0		
2	9.4	12.0	6.2	20	11.1		
3	> 9.0	> 15.0	6.3	21	10.1		
4	> 10.2	> 15.0	7.9	22	12.8		
5	10.6			23	12.2		
6	8.1	11.2	5.8	24	8.4		
7	7.3	9.2	5.6	25	10.6		
8	7.0	8.0	4.8	25-A	10.4		52
9	6.7	9.8	5.0	26	11.6		
10	8.4			27	12.5		
11	12.0			28	7.5		
12	13.0			29	7.5		
13	6.4	10.2	4.0	30	6.6	8.3	3.0
14	6.1	9.2	4.0	31	6.8		
15	5.9	8.5	3.0	32	6.9		
16	8.0			33	9.3		
17	6.4	8.6	4.2	34	9.4		
18	6.2	4.7	4.0	35	9.4		

TABLE 6-A LITTLE MIAMI RIVER SYSTEM

Biochemical Oxygen Demand 2-day, m_d/l

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	3.3	6.5	1.6	19			
2	3.3	5.6	1.4	20			
3	3.3	5.1	1.4	21			
4	4.0	5.5	3.0	22			
5				23			
6	2.7	3.1	1.8	24	1.8		
7	1.8	2.9	0.9	25			
8	1.3	1.9	0.2	25-A			
9	1.7	2.6	1.2	26			
10				27			
11				28	1.4		
12				29	3.0		
13	4.3	4.3	1.0	30	0.8	1.5	0.1
14	2.4	6.4	1.1	31			
15	1.8	3.4	0.8	32	2.9		
16				33	2.1		
17	1.4	3.3	0.6	34			
18	1.3	1.8	0.5	35	1.6		

TABLE 1-4 LITTLE MIAMI FIVER SYSTEM

Photochemical Oxygen Demand $5-\text{Deq}_2, \text{mg/l}$

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	5.1	8.0	2.6	19			
2	5.3	8.3	3.0	20			
3	5.4	7.2	3.2	21			
4	> 6.6	> 8.2	5.2	22			
5				23			
6	4.4	5.3	3.4	24	3.1		
7	3.2	5.0	2.0	25			
8	2.1	3.0	1.4	25-A			
9	2.8	4.0	2.0	26			
10				27			
11				28	2.6		
12				29	5.8		
13	4.2	7.4	2.2	30	1.9	3.0	0.6
14	3.6	5.6	2.2	31			
15	3.3	5.2	2.0	32	6.4		
16				33	3.4		
17	2.6	5.2	1.2	34			
18	2.5	3.6	1.2	35	2.8		

TABLE 8-A LITTLE MIAMI RIVER SYSTEM

pH

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	8.2	8.7	7.0	19	8.5		
2	8.4	8.7	8.0	20	8.1		
3	8.5	8.7	8.0	21	8.4		
4	8.1	8.3	7.8	22	8.1		
5	8.6			23	8.1		
6	8.3	8.5	8.0	24	7.8		
7	8.2	8.5	8.0	25	8.1		
8	8.2	8.4	7.9	25-A	8.2		5.5
9	8.2	8.6	7.8	26	8.2		
10	8.3			27	8.0		
11	8.8			28	7.7		
12	8.7			29	7.5		
13	7.5	8.3	5.6	30	7.5	8.3	5.3
14	7.8	8.2	6.5	31	7.6		
15	7.5	8.4	5.6	32	8.2		
16	8.2			33	7.9		
17	7.6	8.2	6.7	34	8.0		
18	7.7	8.2	7.3	35	7.9		

TABLE 3-3 LITTLE MIAMI RIVER SYSTEM

Total Poliform, MF/100 mi

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	17,123	253,000	1,100	19	203	260	160
2	4,694	44,000	1,000	20	289	350	230
3	13,577	32,000	4,800	21	528	1,050	230
4	35,114	70,000	9,500	22	1,245	3,000	700
5	460	430	420	23	253	500	180
6	762	5,100	300	24	18,986	28,000	13,000
7	736	3,900	320	25	354	900	150
8	1,031	4,100	560	25-A	-	-	-
9	1,613	28,000	360	26	415	2,000	120
10	644	700	560	27	835	2,300	230
11	6,072	8,200	3,200	28	1,536	13,800	100
12	1,644	3,200	960	29	10,770	17,000	7,700
13	18,869	63,000	6,700	30	45,562	104,000	25,000
14	62,720	490,000	23,000	31	470	3,000	160
15	43,747	72,000	25,000	32	11,625	174,000	1,850
16	283	420	180	33	465	900	320
17	11,315	58,000	1,200	34	6,974	20,000	1,600
18	12,237	60,000	2,500	35	1,173	5,200	500

TABLE 10-A LITTLE MIAMI RIVER SYSTEM

Fecal Coliform, MF/100 ml

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	2,832	33,000	150	19	27	48	18
2	1,251	7,600	350	20	58	68	50
3	2,766	8,500	990	21	97	460	30
4	6,949	19,000	1,300	22	134	280	90
5	67	142	34	23	71	98	50
6	260	1,130	100	24	1,694	3,000	1,130
7	138	2,200	54	25	117	250	85
8	163	420	115	25-A	-	-	-
9	404	13,500	54	26	260	1,300	100
10	327	330	320	27	546	1,400	134
11	1,080	1,500	560	28	513	13,000	50
12	601	770	470	29	2,067	3,900	1,200
13	3,865	8,900	840	30	9,013	48,000	3,000
14	15,628	140,000	4,500	31	265	1,900	40
15	6,160	23,000	1,300	32	1,806	40,000	350
16	64	80	56	33	119	340	64
17	2,246	22,000	590	34	1,052	3,100	150
18	1,565	23,000	310	35	264	800	70

TABLE 11-A LITTLE MIAMI RIVER SYSTEM

Nitrogen ($\text{NH}_3\text{-N}$), mg/l

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	0.04	0.07	0.02	19	-		
2	0.04	0.06	0.02	20	-		
3	0.05	0.08	0.02	21	0.03		
4	0.12	0.21	0.04	22	0.62		
5				23	0.03		
6	0.03	0.05	0.02	24	0.14		
7	0.03	0.05	0.02	25	0.04		
8	0.05	0.08	0.03	25-A	0.01		58
9	0.05	0.06	0.03	26	0.01		
10	0.02			27	-		
11	-			28	0.22		
12	0.05			29	0.75		
13	0.06	0.16	0.02	30	0.12	0.19	0.08
14	0.16	0.33	0.07	31	0.02		
15	0.07	0.10	0.02	32	0.03		
16	0.03			33	0.02		
17	0.05	0.22	0.01	34	0.06		
18	0.04	0.38	0.02	35	0.04		

TABLE 12-A LITTLE MIAMI RIVER SYSTEM

Nitrogen (NO_3N), mg/l

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	0.9	1.0	0.8	19	-		
2	0.9	1.0	0.9	20	-		
3	1.0	1.3	0.6	21	2.5		
4	< 0.1	0.2	< 0.1	22	1.9		
5				23	2.6		
6	< 0.1	< 0.1	< 0.1	24	1.8		
7	< 0.1	< 0.1	< 0.1	25	1.7		
8	< 0.2	0.3	< 0.1	25-A	1.2		59
9	< 0.2	0.3	< 0.1	26	2.0		
10	1.5			27	-		
11	-			28	1.2		
12	1.6			29	1.1		
13	1.1	1.2	0.7	30	2.7	3.6	1.8
14	1.2	1.3	1.0	31	1.6		
15	1.6	2.2	0.9	32	1.9		
16	1.5			33	0.7		
17	2.1	2.8	1.5	34	1.7		
18	2.0	2.7	1.5	35	1.0		

TABLE 13-A LITTLE MIAMI RIVER SYSTEM

Nitrogen (Org-N), mg/l

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	1.2	1.7	0.8	19	-		
2	1.0	1.3	0.8	20	-		
3	1.1	1.4	1.0	21	0.9		
4	1.2	1.3	0.9	22	1.4		
5				23	0.7		
6	0.8	1.0	0.5	24	1.0		
7	0.7	0.9	0.3	25	1.0 ^a		
8	0.6	0.8	0.3	25-A	0.6		
9	0.6	0.8	0.4	26	0.3		
10	0.4			27	-		
11	-			28	0.6		
12	1.2			29	0.6		
13	0.9	1.2	0.7	30	< 0.6	0.9	< 0.1
14	0.9	1.3	0.6	31	0.5		
15	0.8	0.9	0.4	32	0.3		
16	0.5			33	0.5		
17	0.7	1.0	0.4	34	0.4		
18	0.6	0.8	0.3	35	0.4		

TABLE 14-A				LITTLE MIAMI RIVER SYSTEM				Total Phosphorus, mg/l			
STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN				
1	0.40	0.49	0.26	19	-						
2	0.37	0.43	0.33	20	-						
3	0.43	0.55	0.38	21	0.02						
4	0.35	0.48	0.22	22	2.70						
5				23	< 0.01						
6	0.13	0.15	0.12	24	0.50						
7	0.06	0.07	0.04	25	0.09						
8	0.18	0.25	0.13	25-A	0.04						
9	0.08	0.13	0.06	26	0.03						
10	0.06			27	-						
11	-			28	0.97						
12	0.03			29	0.67						
13	0.46	0.48	0.45	30	1.41	1.74	1.23				
14	0.60	0.87	0.48	31	0.06						
15	0.49	0.56	0.44	32	0.16						
16	0.51			33	0.05						
17	0.50	0.94	0.43	34	0.14						
18	0.50	0.58	0.43	35	0.12						

TABLE 1.1-4 LITTLE MIAMI RIVER SYSTEM

Soluble Phosphorus, mg/l

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	0.14	0.25	0.03	19			
2	0.20	0.33	0.10	20			
3	0.26	0.36	0.19	21			
4	0.14	0.28	0.02	22			
5				23			
6	0.04	0.06	0.02	24			
7	< 0.01	0.02	< 0.01	25			
8	0.10	0.13	0.08	25-A			62
9	0.03	0.05	0.01	26			
10				27			
11				28			
12				29			
13	0.32	0.38	0.28	30	1.39	1.80	1.11
14	0.45	0.66	0.34	31			
15	0.36	0.41	0.31	32			
16				33			
17	0.42	0.51	0.35	34			
18	0.43	0.53	0.35	35			

TABLE 16-A LITTLE MIAMI RIVER SYSTEM

Conductivity, μ mhos

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	606	638	565	19	420		
2	608	626	575	20	500		
3	624	648	613	21	410		
4	527	555	509	22	590		
5	380			23	575		
6	470	497	456	24	520		
7	456	480	439	25	540		
8	486	515	451	25-A	450		63
9	496	529	454	26	490		
10	425			27	500		
11	440			28	540		
12	440			29	630		
13	637	666	618	30	659	678	635
14	621	660	586	31	490		
15	622	661	575	32	400		
16	340			33	520		
17	647	664	622	34	530		
18	653	676	633	35	740		

TABLE 16-A LITTLE MIAMI RIVER SYSTEM

Conductivity, μ mhos							
STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	606	638	565	19	420		
2	608	626	575	20	500		
3	624	648	613	21	410		
4	527	555	509	22	590		
5	380			23	575		
6	470	497	456	24	520		
7	456	480	439	25	540		
8	486	515	451	25-A	450		63
9	496	529	454	26	490		
10	425			27	500		
11	440			28	540		
12	440			29	630		
13	637	666	618	30	659	678	635
14	621	660	586	31	490		
15	622	661	575	32	400		
16	340			33	520		
17	647	664	622	34	530		
18	653	676	633	35	740		

TABLE 17-a LITTLE MIAMI RIVER SYSTEM

Alkalinity, mg/l

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	236	252	216	19			
2	242	246	238	20			
3	250	269	240	21			
4	219	234	208	22			
5				23			
6	194	204	180	24			
7	188	202	175	25			
8	202	205	196	25-A			28
9	199	208	192	26			
10				27			
11				28			
12				29			
13	257	270	246	30	296	317	285
14	256	276	244	31			
15	288	336	254	32			
16				33			
17	270	280	260	34			
18	272	281	262	35			

TABLE 1B-A LITTLE MIAMI RIVER SYSTEM

TABLE 18-A		LITTLE MIAMI RIVER SYSTEM			Hardness, mg/l			
STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN	
1	281	312	234	19				
2	304	312	297	20				
3	306	327	263	21				
4	268	280	256	22				
5				23				
6	207	250	166	24				
7	232	246	214	25				
8	248	254	238	25-A			65	
9	226	258	186	26				
10				27				
11				28				
12				29				
13	316	340	285	30	340	348	321	
14	316	347	298	31				
15	327	348	295	32				
16				33				
17	308	341	230	34				
18	334	345	326	35				

TABLE 10-A LITTLE MIAMI RIVER SYSTEM

Tributaries, miles

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	16	52	14	19			
2	16	20	12	20			
3	14	17	11	21			
4	13	22	12	22			
5				23			
6	9	11	6	24			
7	8	11	5	25			
8	9	11	7	25-A			66
9	14	24	8	26			
10				27			
11				28			
12				29			
13	13	15	11	30	7	11	4
14	22	28	13	31			
15	20	34	14	32			
16				33			
17	11	14	8	34			
18	13	15	9	35			

TABLE 20-A LITTLE MIAMI RIVER SYSTEM

Color, units

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	24	35	15	19			
2	20	25	15	20			
3	21	25	15	21			
4	22	25	15	22			
5				23			
6	22	30	15	24			
7	20	25	15	25			
8	20	25	15	25-A			
9	18	20	15	26			
10				27			
11				28			
12				29			
13	19	20	15	30	14	20	10
14	19	20	15	31			
15	20	25	15	32			
16				33			
17	15	20	10	34			
18	14	15	10	35			

TABLE 42-6. LITTLE MIAMI RIVER SYSTEM.

Chlorides, mg/l

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	30	33	28	19			
2	30	33	27	20			
3	31	36	24	21			
4	19	26	18	22			
5				23			
6	16	17	15	24			
7	19	19	15	25			
8	19	16	14	25-A			
9	14	17	12	26			
10				27			
11				28			
12				29			
13	32	38	26	30	22	27	18
14	28	29	25	31			
15	26	29	22	32			
16				33			
17	26	28	24	34			
18	26	28	24	35			

TABLE 22-A LITTLE MIAMI RIVER SYSTEM

Sulfates, mg/l

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	59	65	55	19			
2	60	65	54	20			
3	60	68	57	21			
4	56	60	50	22			
5				23			
6	52	57	47	24			
7	53	56	49	25			
8	54	56	52	25-A			69
9	58	63	55	26			
10				27			
11				28			
12				29			
13	62	64	57	30	52	55	49
14	59	63	55	31			
15	61	64	58	32			
16				33			
17	60	63	59	34			
18	61	65	58	35			

TABLE 2-6 LITTLE MIAMI RIVER SYSTEM

Total Solids, mg/l

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	469	534	460	19			
2	456	475	436	20			
3	485	532	443	21			
4	405	461	371	22			
5				23			
6	349	383	308	24			
7	322	358	291	25			
8	361	410	341	25-A			
9	373	378	368	26			
10				27			
11				28			
12				29			
13	479	523	444	30	505	548	480
14	479	494	467	31			
15	485	524	457	32			
16				33			
17	460	481	433	34			
18	471	485	430	35			

TABLE 24-A LITTLE MIAMI RIVER SYSTEM

Dissolved Solids, mg/l

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	433	444	413	19			
2	428	446	412	20			
3	450	487	422	21			
4	374	412	322	22			
5				23			
6	331	369	280	24			
7	293	322	265	25			
8	350	398	325	25-A			71
9	350	364	336	26			
10				27			
11				28			
12				29			
13	450	489	415	30	492	534	473
14	435	474	409	31			
15	446	490	395	32			
16				33			
17	439	459	416	34			
18	450	458	430	35			

TABLE 25-A LITTLE MIAPI RIVER SYSTEM

Suspended Solids, mg/l

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	56	91	36	19			
2	29	34	22	20			
3	34	45	21	21			
4	32	49	18	22			
5				23			
6	18	28	10	24			
7	18	26	12	25			
8	10	16	3	25-A			72
9	23	42	8	26			
10				27			
11				28			
12				29			
13	29	39	19	30	13	24	7
14	44	62	11	31			
15	38	62	15	32			
16				33			
17	21	22	17	34			
18	20	25	15	35			

TABLE 26-A

LITTLE MIAMI RIVER SYSTEM

Volatile Solids, mg/l

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	14	18	5	19			
2	8	11	4	20			
3	10	14	2	21			
4	10	17	4	22			
5				23			
6	7	14	2	24			
7	8	12	6	25			
8	4	6	1	25-A			
9	5	9	1	26			
10				27			
11				28			
12				29			
13	6	11	3	30	3	5	2
14	11	19	2	31			
15	9	14	5	32			
16				33			
17	5	8	0	34			
18	6	10	1	35			

TABLE 47-A LITTLE MIAMI RIVER SYSTEM

Calcium, mg/l

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	48	52	45	19			
2	48	51	45	20			
3	50	50	50	21			
4	47	49	46	22			
5				23			
6	40	42	38	24			
7	38	40	36	25			
8	41	45	37	25-A			74
9	40	42	37	26			
10				27			
11				28			
12				29			
13	50	53	49	30	54	55	52
14	51	53	50	31			
15	51	53	48	32			
16				33			
17	51	53	50	34			
18	52	53	50	35			

TABLE 28-A LITTLE MIAMI RIVER SYSTEM

Magnesium (Calc.), mg/l

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	39	45	25	19			
2	44	45	44	20			
3	44	49	34	21			
4	36	38	34	22			
5				23			
6	26	35	16	24			
7	33	35	30	25			
8	35	37	33	25-A			75
9	31	38	20	26			
10				27			
11				28			
12				29			
13	46	50	39	30	51	57	46
14	46	52	42	31			
15	48	52	42	32			
16				33			
17	44	52	24	34			
18	50	52	48	35			

Total Iron, mg/l

TABLE 23-A LITTLE MIAMI RIVER SYSTEM

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	0.7	1.1	0.5	19			
2	0.4	0.5	0.2	20			
3	0.4	0.5	0.3	21			
4	0.4	0.6	0.4	22			
5				23			
6	0.2	0.3	0.2	24			
7	0.2	0.3	0.2	25			
8	0.3	0.3	0.2	25-A			
9	0.4	0.6	0.3	26			
10				27			
11				28			
12				29			
13	0.4	0.5	0.3	30	0.3	0.5	0.2
14	0.8	1.1	0.3	31			
15	0.6	1.1	0.4	32			
16				33			
17	0.4	0.5	0.3	34			
18	0.4	0.5	0.3	35			

TABLE 30-A LITTLE MIAMI RIVER SYSTEM

Manganese, mg/l

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	0.12	0.16	0.10	19			
2	0.09	0.10	0.08	20			
3	0.10	0.10	0.10	21			
4	0.20	0.22	0.18	22			
5				23			
6	0.12	0.17	0.09	24			
7	0.03	0.12	0.06	25			
8	0.06	0.08	0.04	25-A			77
9	0.03	0.10	0.08	26			
10				27			
11				28			
12				29			
13	0.08	0.10	0.07	30	0.04	0.06	0.03
14	0.10	0.12	0.06	31			
15	0.08	0.11	0.06	32			
16				33			
17	0.05	0.07	0.04	34			
18	0.06	0.08	0.04	35			

TABLE 31-A LITTLE MIAMI RIVER SYSTEM

Sodium, mg/l

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	17.0	19.0	15.0	19			
2	16.8	18.9	14.8	20			
3	17.4	20.0	14.8	21			
4	11.4	13.6	10.0	22			
5				23			
6	10.2	11.6	8.8	24			
7	8.8	10.0	8.2	25			
8	9.5	10.8	8.4	25-A			78
9	8.6	9.4	8.0	26			
10				27			
11				28			
12				29			
13	18.3	20.0	15.4	30	17.7	19.4	15.0
14	16.2	19.0	14.2	31			
15	15.2	17.6	13.2	32			
16				33			
17	15.0	16.2	13.4	34			
18	15.4	16.2	14.4	35			

TABLE 32-A LITTLE MIAMI RIVER SYSTEM

Potassium, mg/l

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	3.1	3.6	2.7	19			
2	2.8	3.1	2.6	20			
3	2.8	3.0	2.6	21			
4	2.4	2.7	1.8	22			
5				23			
6	2.0	2.5	1.8	24			
7	1.8	2.2	1.5	25			
8	1.8	2.3	1.6	25-A			
9	3.0	5.8	1.8	26			
10				27			
11				28			
12				29			
13	2.9	3.2	2.7	30	3.0	3.6	2.6
14	3.2	3.5	2.7	31			
15	2.9	3.6	2.6	32			
16				33			
17	2.6	3.0	2.4	34			
18	2.7	3.0	2.5	35			

TABLE 33-A LITTLE MIAMI RIVER SYSTEM

Aluminum, mg/l

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	1.4	2.6	0.6	19			
2	<0.6	1.2	<0.5	20			
3	<0.6	1.0	<0.5	21			
4	<0.6	0.9	<0.5	22			
5				23			
6	<0.5	<0.5	<0.5	24			
7	<0.5	<0.5	<0.5	25			
8	<0.5	0.5	<0.5	25-A			80
9	<0.7	1.2	<0.5	26			
10				27			
11				28			
12				29			
13	<0.6	0.8	<0.5	30	0.8	1.2	0.6
14	<1.7	4.0	<0.5	31			
15	<1.3	2.6	<0.5	32			
16				33			
17	<0.6	0.7	<0.5	34			
18	<0.8	1.4	<0.5	35			

TABLE 34-A LITTLE MIAMI RIVER SYSTEM

Cadmium, mg/l						
STATION	AVG	MAX	MIN	STATION	AVG	MIN
1	< 0.01	< 0.01	< 0.01	19		
2	< 0.01	< 0.01	< 0.01	20		
3	< 0.01	< 0.01	< 0.01	21		
4	< 0.01	< 0.01	< 0.01	22		
5				23		
6	< 0.01	< 0.01	< 0.01	24		
7	< 0.01	< 0.01	< 0.01	25		
8	< 0.01	< 0.01	< 0.01	25-A		
9	< 0.01	< 0.01	< 0.01	26		
10				27		
11				28		
12				29		
13	< 0.01	< 0.01	< 0.01	30	< 0.01	< 0.01
14	< 0.01	< 0.01	< 0.01	31		
15	< 0.01	< 0.01	< 0.01	32		
16				33		
17	< 0.01	< 0.01	< 0.01	34		
18	< 0.01	< 0.01	< 0.01	35		

TABLE 35-A LITTLE MIAMI RIVER SYSTEM

Chromium, mg/l

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	< 0.02	< 0.02	< 0.02	19			
2	< 0.02	< 0.02	< 0.02	20			
3	< 0.02	< 0.02	< 0.02	21			
4	< 0.02	< 0.02	< 0.02	22			
5				23			
6	< 0.02	< 0.02	< 0.02	24			
7	< 0.02	< 0.02	< 0.02	25			
8	< 0.02	< 0.02	< 0.02	25-A			
9	< 0.02	< 0.02	< 0.02	26			
10				27			
11				28			
12				29			
13	< 0.02	< 0.02	< 0.02	30	< 0.02	< 0.02	< 0.02
14	< 0.02	< 0.02	< 0.02	31			
15	< 0.02	< 0.02	< 0.02	32			
16				33			
17	< 0.02	< 0.02	< 0.02	34			
18	< 0.02	< 0.02	< 0.02	35			

TABLE 36-A LITTLE MIAMI RIVER SYSTEM

Copper, mg/l

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	< 0.01	0.03	< 0.01	19			
2	< 0.01	< 0.01	< 0.01	20			
3	< 0.01	0.01	< 0.01	21			
4	< 0.01	0.02	< 0.01	22			
5				23			
6	< 0.01	0.01	< 0.01	24			
7	< 0.01	< 0.01	< 0.01	25			
8	< 0.01	< 0.01	< 0.01	25-A			83
9	< 0.01	0.02	0.00	26			
10				27			
11				28			
12				29			
13	0.02	0.04	0.00	30	< 0.01	< 0.01	< 0.01
14	< 0.01	0.02	< 0.01	31			
15	< 0.02	0.06	< 0.01	32			
16				33			
17	< 0.01	0.01	< 0.01	34			
18	< 0.01	0.02	0.00	35			

TABLE 37-A LITTLE MIAMI RIVER SYSTEM

Lead, mg/l

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	< 0.6	< 0.6	< 0.6	19			
2	< 0.6	< 0.6	< 0.6	20			
3	< 0.6	< 0.6	< 0.6	21			
4	< 0.6	< 0.6	< 0.6	22			
5				23			
6	< 0.6	< 0.6	< 0.6	24			
7	< 0.6	< 0.6	< 0.6	25			
8	< 0.6	< 0.6	< 0.6	25-A			
9	< 0.6	< 0.6	< 0.6	26			
10				27			
11				28			
12				29			
13	< 0.6	< 0.6	< 0.6	30	< 0.6	< 0.6	< 0.6
14	< 0.6	< 0.6	< 0.6	31			
15	< 0.6	< 0.6	< 0.6	32			
16				33			
17	< 0.6	< 0.6	< 0.6	34			
18	< 0.6	< 0.6	< 0.6	35			

TABLE 38-A LITTLE MIAMI RIVER SYSTEM

Zinc, mg/l

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	< 0.03	0.08	< 0.01	19			
2	< 0.03	0.05	< 0.01	20			
3	< 0.01	0.02	< 0.01	21			
4	< 0.02	0.03	< 0.01	22			
5				23			
6	< 0.01	0.02	< 0.01	24			
7	< 0.01	0.01	< 0.01	25			
8	< 0.01	0.02	< 0.01	25-A			85
9	< 0.02	0.02	< 0.01	26			
10				27			
11				28			
12				29			
13	< 0.02	0.04	< 0.01	30	< 0.01	0.02	< 0.01
14	< 0.02	0.02	< 0.01	31			
15	< 0.03	0.08	< 0.01	32			
16				33			
17	< 0.01	0.02	< 0.01	34			
18	< 0.02	0.03	< 0.01	35			

TABLE 39-A LITTLE MIAMI RIVER SYSTEM

Nickel, mg/l

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	< 0.10	< 0.10	< 0.10	19			
2	< 0.10	< 0.10	< 0.10	20			
3	< 0.10	< 0.10	< 0.10	21			
4	< 0.10	< 0.10	< 0.10	22			
5				23			
6	< 0.10	< 0.10	< 0.10	24			
7	< 0.10	< 0.10	< 0.10	25			
8	< 0.10	< 0.10	< 0.10	25-A			
9	< 0.10	< 0.10	< 0.10	26			
10				27			
11				28			
12				29			
13	< 0.10	< 0.10	< 0.10	30	< 0.10	< 0.10	< 0.10
14	< 0.10	< 0.10	< 0.10	31			
15	< 0.10	< 0.10	< 0.10	32			
16				33			
17	< 0.10	< 0.10	< 0.10	34			
18	< 0.10	< 0.10	< 0.10	35			

TABLE 40-A LITTLE MIAMI RIVER SYSTEM

Oils, mg/l

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	11	24	3	19			
2	< 6	18	< 1	20			
3	< 16	38	< 1	21			
4	< 26	57	< 1	22			
5				23			
6	< 1	< 1	< 1	24			
7	< 6	19	< 1	25			
8	< 12	40	< 1	25-A			87
9	< 8	29	< 1	26			
10				27			
11				28			
12				29			
13	< 25	96	< 1	30	< 1	2	< 1
14	< 22	81	< 1	31			
15	10	31	1	32			
16				33			
17	< 25	91	< 1	34			
18	< 19	69	< 1	35			

TABLE 41-A

LITTLE MIAMI RIVER SYSTEM

Total Organic Carbon (TOC), mg/l

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	4.5	7.9	3.2	19			
2	4.2	5.5	3.0	20			
3	4.9	6.9	3.4	21			
4	5.0	6.6	3.6	22			
5				23			
6	4.2	5.0	3.6	24			
7	4.2	4.7	3.6	25			
8	3.9	5.0	3.4	25-A			88
9	4.6	6.0	3.6	26			
10				27			
11				28			
12				29			
13	3.7	5.5	2.8	30	4.4	7.8	2.0
14	4.0	5.8	2.1	31			
15	3.6	5.0	2.8	32			
16				33			
17	2.4	3.0	1.5	34			
18	2.8	3.0	2.6	35			

TABLE 42-A

LITTLE MIAMI RIVER SYSTEM

Chemical Oxygen Demand (COD), mg/l

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	< 40	< 40	< 40	19			
2	< 40	< 40	< 40	20			
3	< 40	< 40	< 40	21			
4	< 40	< 40	< 40	22			
5				23			
6	< 40	< 40	< 40	24			
7	< 40	< 40	< 40	25			
8	< 40	< 40	< 40	25-A			89
9	< 40	< 40	< 40	26			
10				27			
11				28			
12				29			
13	< 40	< 40	< 40	30	< 40	< 40	< 40
14	< 40	< 40	< 40	31			
15	< 44	54	< 40	32			
16				33			
17	< 40	< 40	< 40	34			
18	< 40	< 40	< 40	35			

TABLE 43-A LITTLE MIAMI RIVER SYSTEM

Arsenic, mg/l

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	< 0.02	< 0.02	< 0.01	19			
2	< 0.02	< 0.02	< 0.02	20			
3	< 0.02	< 0.02	< 0.02	21			
4	< 0.02	< 0.02	< 0.02	22			
5				23			
6	< 0.02	< 0.02	< 0.02	24			
7	< 0.02	< 0.02	< 0.02	25			
8	< 0.02	< 0.02	< 0.02	25-A			
9	< 0.02	0.03	< 0.01	26			
10				27			
11				28			
12				29			
13	< 0.02	0.02	< 0.02	30	< 0.02	< 0.02	< 0.02
14	< 0.02	< 0.02	< 0.02	31			
15	< 0.02	< 0.02	< 0.02	32			
16				33			
17	< 0.02	< 0.02	< 0.02	34			
18	< 0.02	< 0.02	< 0.02	35			

TABLE 44-A LITTLE MIAMI RIVER SYSTEM

Cyanide, mg/l

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	< 0.01	< 0.01	< 0.01	19			
2	< 0.01	< 0.01	< 0.01	20			
3	< 0.01	< 0.01	< 0.01	21			
4	< 0.01	< 0.01	< 0.01	22			
5				23			
6	< 0.01	< 0.01	< 0.01	24			
7	< 0.01	< 0.01	< 0.01	25			
8	< 0.01	< 0.01	< 0.01	25-A			
9	< 0.01	< 0.01	< 0.01	26			
10				27			
11				28			
12				29			
13	< 0.01	< 0.01	< 0.01	30	< 0.01	< 0.01	< 0.01
14	< 0.01	< 0.01	< 0.01	31			
15	< 0.01	< 0.01	< 0.01	32			
16				33			
17	< 0.01	< 0.01	< 0.01	34			
18	< 0.01	< 0.01	< 0.01	35			

TABLE 45-A

LITTLE MIAMI RIVER SYSTEM

Phenols, mg/l

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	< 0.005	< 0.005	< 0.005	19			
2	< 0.005	< 0.005	< 0.005	20			
3	< 0.006	0.007	< 0.005	21			
4	< 0.007	0.010	< 0.005	22			
5				23			
6	< 0.005	< 0.005	< 0.005	24			
7	< 0.005	0.005	< 0.005	25			
8	< 0.005	< 0.005	< 0.005	25-A			
9	< 0.005	< 0.005	< 0.005	26			
10				27			
11				28			
12				29			
13	< 0.005	< 0.005	< 0.005	30	< 0.005	< 0.005	< 0.005
14	< 0.005	0.005	< 0.005	31			
15	< 0.005	< 0.005	< 0.005	32			
16				33			
17	< 0.005	< 0.005	< 0.005	34			
18	< 0.005	0.005	< 0.005	35			

TABLE 46-A LITTLE MIAMI RIVER SYSTEM

Fluorides, mg/l

STATION	AVG	MAX	MIN	STATION	AVG	MAX	MIN
1	0.41	0.42	0.40	19			
2	0.50	0.60	0.30	20			
3	0.60	0.80	0.40	21			
4	0.40	0.50	0.30	22			
5				23			
6	0.30	0.40	0.20	24			
7	0.30	0.40	0.30	25			
8	0.30	0.40	0.30	25-A			
9	0.40	0.40	0.30	26			
10				27			
11				28			
12				29			
13	0.30	0.30	0.20	30	0.40	0.50	0.30
14	0.30	0.40	0.20	31			
15	0.30	0.40	0.30	32			
16				33			
17	0.40	0.40	0.30	34			
18	0.40	0.50	0.30	35			

APPENDIX B

APPENDIX B

WATER POLLUTION CONTROL BOARD
OHIO DEPARTMENT OF HEALTH
COLUMBUS, OHIO

RESOLUTION REGARDING AMENDED CRITERIA
of
STREAM-WATER QUALITY FOR VARIOUS USES
(Adopted October 10, 1967)

WHEREAS, Section 6111.03 of the Ohio Revised Code, provides, in part, as follows:

"The water pollution control board shall have power:

(A) To develop programs for the prevention, control and abatement of new or existing pollution of the waters of the state; . . ." and

WHEREAS, Primary indicators of stream-water quality are needed as guides for appraising the suitability of surface waters in Ohio for various uses; and

WHEREAS, The stream-water quality criteria for various uses and minimum conditions applicable to all waters adopted by the Board on June 14, 1966, have been amended by the Ohio River Valley Water Sanitation Commission;

THEREFORE BE IT RESOLVED, That the following amended stream-water quality criteria for various uses, and minimum conditions applicable to all waters, are hereby adopted in accordance with amendments of the Ohio River Valley Water Sanitation Commission.

MINIMUM CONDITIONS APPLICABLE
to
ALL WATERS AT ALL PLACES
and
AT ALL TIMES

1. Free from substances attributable to municipal, industrial or other discharges or agricultural practices that will settle to form putrescent or otherwise objectionable sludge deposits.

2. Free from floating debris, oil, scum and other floating materials attributable to municipal, industrial or other discharges, or agricultural practices in amounts sufficient to be unsightly or deleterious.
3. Free from materials attributable to municipal, industrial or other discharges, or agricultural practices producing color, odor or other conditions in such degree as to create a nuisance.
4. Free from substances attributable to municipal, industrial or other discharges or agricultural practices in concentrations or combinations which are toxic or harmful to human, animal, plant or aquatic life.

STREAM-QUALITY CRITERIA

FOR PUBLIC WATER SUPPLY

The following criteria are for evaluation of stream quality at the point at which water is withdrawn for treatment distribution as a potable supply:

1. Bacteria: Coliform group not to exceed 5,000 per 100 ml as a monthly average value (either MPN or MF count); nor exceed this number in more than 20 percent of the samples examined during any month; nor exceed 20,000 per 100 ml in more than five percent of such samples.
2. Threshold-odor Number: Not to exceed 24 (at 60 deg. C.) as a daily average.
3. Dissolved solids: Not to exceed 500 mg/l as a monthly average value, nor exceed 750 mg/l at any time.
4. Radioactivity: Gross beta activity not to exceed 1,000 picocuries per liter (pCi/l), nor shall activity from dissolved strontium-90 exceed 10 pCi/l, nor shall activity from dissolved alpha emitters exceed 3 pCi/l.
5. Chemical constituents: Not to exceed the following specified concentrations at any time:

<u>Constituent</u>	<u>Concentration (mg/l)</u>
Arsenic	0.05
Barium	1.0
Cadmium	0.01
Chromium(hexavalent)	0.05
Cyanide	0.025
Fluoride	1.0
Lead	0.05
Selenium	0.01
Silver	0.05

FOR INDUSTRIAL WATER SUPPLY

The following criteria are applicable to stream water at the point at which the water is withdrawn for use (either with or without treatment) for industrial cooling and processing:

1. Dissolved oxygen: Not less than 2.0 mg/l as a daily-average value nor less than 1.0 mg/l at any time.
2. pH: Not less than 5.0 nor greater than 9.0 at any time.
3. Temperature: Not to exceed 95 deg. F. at any time.
4. Dissolved solids: Not to exceed 750 mg/l as a monthly average value nor exceed 1,000 mg/l at any time.

FOR AQUATIC LIFE A

The following criteria are for evaluation of conditions for the maintenance of a well-balanced, warm-water fish population. They are applicable at any point in the stream except for areas immediately adjacent to outfalls. In such areas cognizance will be given to opportunities for the admixture of waste effluents with stream water:

1. Dissolved oxygen: Not less than 5.0 mg/l during at least 16 hours of any 24-hour period, nor less than 3.0 mg/l at any time.
2. pH: No values below 5.0 nor above 9.0, and daily average (or median) values preferably between 6.5 and 8.5.
3. Temperature: Not to exceed 93 deg. F. at any time during the months of May through November, and not to exceed 73 deg. F. at any time during the months of December through April.
4. Toxic substances: Not to exceed one-tenth of the 48-hour median tolerance limit, except that other limiting concentrations may be used in specific cases when justified on the basis of available evidence and approved by the appropriate regulatory agency.

FOR AQUATIC LIFE B

The following criteria are for evaluation of conditions for the maintenance of desirable biological growths and, in limited stretches of a stream for permitting the passage of fish through the water, except for areas immediately adjacent to outfalls. In such areas cognizance will be given to opportunities for admixture of effluents with stream water:

1. Dissolved oxygen: Not less than 2.0 mg/l as a daily average value, nor less than 1.0 mg/l at any time.
2. pH: Not less than 5.0 nor greater than 9.0 at any time.
3. Temperature: Not to exceed 95 deg. F. at any time.
4. Toxic substances: Not to exceed one-tenth of the 48-hour median tolerance limit, except that other limiting concentrations may be used in specific cases when justified on the basis of available evidence and approved by the appropriate regulatory agency.

FOR RECREATION

The following criterion is for evaluation of conditions at any point in waters designated to be used for recreational purposes including such water-contact activities as swimming and water skiing.

Bacteria: Coliform group not to exceed 1,000 per 100 ml as a monthly average value (either MPN or MF count); nor exceed this number in more than 20 percent of the samples examined during any month; nor exceed 2,400 per 100 ml (MPN or MF count) on any day.

FOR AGRICULTURAL USE AND STOCK WATERING

The following criteria are applicable for the evaluation of stream quality at places where water is withdrawn for agricultural use or stock-watering purposes:

1. Free from substances attributable to municipal, industrial or other discharges, or agricultural practices that will settle to form putrescent or otherwise objectionable sludge deposits.
2. Free from floating debris, oil, scum and other floating materials attributable to municipal, industrial or other discharges, or agricultural practices in amounts sufficient to be unsightly or deleterious.
3. Free from materials attributable to municipal, industrial or other discharges, or agricultural practices producing color, odor or other conditions in such degree as to create a nuisance.
4. Free from substances attributable to municipal, industrial or other discharges or agricultural practices in concentrations or combinations which are toxic or harmful to human, animal, plant or aquatic life.